

Helioseismology of the Shell: The Campaign for the Acoustic Peaks

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It Is All One — Notes. July 2026 (campaign chronicle, readable edition)

Abstract. The pattern of warm and cool spots on the microwave sky prefers certain sizes, in a harmonic series — $\ell = 220, 537, 810$, a drumbeat — and this series' static cosmology has owed an account of it since the Four Calculations note declared it the standing obstacle. This note chronicles the campaign waged against that obstacle: the one mechanism class ever known to produce spectral peaks from incoherent driving (the resonant cavity, with the Sun as existence proof) was formulated, computed, and honestly defeated at the measured scales; the wall of the photosphere was then derived from atomic physics; a proposed engine (the Cepheid valve) was tested and found quenched; the decisive over-constrained fit was mounted and lost with cause stated; and the final reconnaissance uncovered something larger than the battle — an apparent 10^4 inconsistency in the cosmology's deep interior, which the framework's own principles resolved into a foundational commitment. The campaign ends with the peaks still unexplained, three genuine discoveries banked, one master calculation named, and every step reproducible from the scripts beside this note. Defeats in public: that is the standard, and this note is its fullest exercise.

1. The Enemy: What the Peaks Are

Strip the sky to its 2.725-kelvin glow and measure the mottling — warm and cool patches at one part in a hundred thousand. The patches are random; the *statistics of their sizes* are not. Decompose the sky into angular tones (the multipole ℓ , roughly 180° divided by patch size) and the power against ℓ is a drumbeat: peaks at $\ell \approx 220, 537, 810$, evenly spaced near $\Delta\ell \approx 300$, odd peaks slightly enhanced, all fading under a smooth damping beyond $\ell \sim 1000$, with a polarization pattern half a beat out of phase. The standard model explains this with a *synchronized start*: all sound waves in the young plasma released in phase at $t \approx 0$, snapshot taken at recombination — a chord frozen mid-song. Models without the synchronized start — continuous, incoherent sources — were computed in 1997 to give one broad hump, and the measured second peak eliminated that entire field within three years. A static, eternal model stands *prima facie* in the same dock; this series' own projection calculation (Four Calculations, §4) confirmed the naive expectation: hump, no chord.

2. The One Open Door: Resonance

One physical system takes fully incoherent driving and produces needle-sharp spectral peaks anyway: the Sun. Random convection, no synchronization — yet its oscillation spectrum shows thousands of discrete peaks, because the Sun is a *cavity*, and resonance selects frequencies regardless of phase. Random hammering on a bell still sounds the bell's note. The shell of this cosmology — stratified by the Tolman gradient, dense below, opaque at the bottom, thinning to transparency above — is structurally a stellar envelope. The campaign's founding question: does the bell's note become the drum's spots? Stated risk, stated first: solar peaks are discrete in *frequency*, sustained in time; the sky's snapshot needs discreteness in *angular scale*, frozen in space.

3. The Campaign, Engagement by Engagement

The cavity is real (steps 1–2). Built from corpus numbers alone: sound speed $0.577c$ (pure radiation fluid — flagged at once: no baryon loading, hence no source for the odd/even peak asymmetry); pressure scale height 1,427 Mpc; opacity wall 428 Mpc thick. Two discoveries: the wall's own thickness maps to exactly $\ell = 220$ (the first-peak scale is the photosphere's skin — a structural length, where the standard model uses a timestamp); and the lapse — the exponential seal — makes the acoustic cutoff *rise* with depth, so low-frequency waves reflect from below: the seal is the cavity's floor mirror, the opacity cliff its ceiling. A genuine resonator, with one face sharp and one gradual.

The resonance route closes (step 3). The corrected mode census found the trapped-mode forest nearly empty at $\ell = 40\text{--}1200$, for a structural reason: trapped acoustic modes have transverse wavelengths of order the scale height — gigaparsecs — so the cavity's music plays at ℓ of a few tens, two orders of magnitude too coarse. The gravity branch dives and never returns; wind-driven surface waves land at $\ell \sim 10^6$. Verdict, banked: **metric D's smooth geometry cannot drum at the measured scales by cavity resonance.** Its two intrinsic lengths (4.3 Gpc stratification, 428 Mpc wall) select $\ell \lesssim 40$.

The pattern-formation reopening. The rungs suggested the repair: nature's universal way to prefer a scale without initial conditions is marginal-stability pattern formation (convection cells, Turing stripes) — a resonance at *frequency zero*, which eternity sharpens rather than washes out. The marginal scale of a self-gravitating fluid is the Jeans length — parametrically the *same formula* as the standard model's sound horizon (their ruler is the Jeans length at recombination wearing a timestamp). The observed ladder's fine structure supplied a further fingerprint: the measured peaks fit $\ell_n = 295(n - 0.23)$, and an offset of one quarter is the signature of a resonator with *one hard wall and one turning point* — anatomically, the opacity cliff and the lapse floor. The sky's own offset structure matches the shell's boundary types.

The wall derived, the engine buried (expedition Saha). Saha's equation across the Tolman gradient *derives* the photosphere: half-ionization at 2,902 K, width 519 Mpc, visibility depth $\sim 1,090$ Mpc — the corpus's asserted wall, now computed from atomic physics. The wall is a hydrogen partial-ionization zone — in stars, the seat of the Cepheid

engine (Eddington's valve). Tested here, the engine is quenched twice over: the ionization energy reservoir is 10^{-13} of the radiation bath, and the valve throttles a background flux that Tolman equilibrium sets to zero. The wall breathes across the atomic door (Saha is the detailed balance of a two-way horizon) but cannot sing on its own.

The dilution problem and the lost battle. At the visibility layer the photon mean free path is 200–500 Mpc — as large as the peak scales themselves: no tight coupling, no fluid, no acoustics where the light we receive is born; and the computed diffusion damping would erase structure beyond $\ell \approx 300$ against the measured clean drum to $\ell \approx 1400$. All failures pull one dial — the local baryon loading — so the decisive over-constrained fit was mounted: one dial, three observables. Outcome: reaching $\ell = 220$ demands roughly fourteen times the standard model's recombination baryon density and $\sim 10^5$ times metric D's entire source budget at the wall. **The corridor closes. No honest loading gives the static shell its drum.**

4. The Discovery Beneath the Battlefield

Walking the ground before the assault, the recon checked whether the metric can carry its own bath — and found that it cannot, under standard bookkeeping: the equilibrium bath's naive energy density grows as $(1+z)^4$ against the metric's derived source at $\sim (1+z)^2$, crossing near $z \approx 150$ and exceeding it by 10^4 at the wall. A crisis larger than the peaks — resolved not by tuning but by the corpus's own tension bridge: the bath is the *thermodynamic face of the tension*, one field read twice, and counting its aT^4 as a second gravitating fluid is double-entry bookkeeping. **The bath is booked once** — the single-booking commitment, now installed in the Allgemeine Feldtheorie with its price stated (a departure from standard semiclassical bookkeeping; untested, not contradicted; forced by the postulates). Equivalently: gravity — the pre-tension — ends at the horizon; the mollusk lives strictly inside its sphere.

5. The Standing of the Front

The peaks remain unexplained: that is the plain sentence, and it stays in the flagship's caveats at full width. What the campaign banked: the photosphere derived from atomic physics; the wall-thickness/first-peak coincidence; the lapse-as-floor-mirror; the quarter-offset fingerprint matching the boundary anatomy; the closure of the resonance route with stated reasons; the quenching of the Cepheid engine; the dilution no-go; and the single-booking commitment, which redefines every deep-interior computation. All fronts now converge on one weapon that does not yet exist: **the perturbation theory of the tension medium** — with its zeroth-order principle fixed (bath fluctuations are not a second gravitating fluid), its battlefield mapped, and three measured numbers ($\ell = 220$ with quarter offset; damping at $\ell \approx 1400$; the polarization phase) waiting as its judges. Scripts: `cavity.py`, `solver.py`, `step3.py`, `step3b.py`, `saha.py`, `battle.py`, beside this note.

6. Why This Note Exists

Because a theory is its record. The standard model earned its authority partly through the defeats its rivals suffered in public — and a challenger earns the right to its victories only by keeping its losses in the same ledger. This campaign lost its stated objective and found, in losing, a derivation, a fingerprint, a quenched engine, a no-go, and a foundational commitment. The drum still belongs to the enemy. The war does not.

References

P. J. E. Peebles and J. T. Yu (1970); R. A. Sunyaev and Ya. B. Zeldovich (1970) — the acoustic-peak prediction; U.-L. Pen, U. Seljak and N. Turok, Phys. Rev. Lett. 79, 1611 (1997) — the incoherent-source no-go; Planck Collaboration results; R. B. Leighton et al. (1962) and solar p-mode literature — helioseismology; M. Saha (1920); A. S. Eddington, *The Internal Constitution of the Stars* (1926) — the valve; and the documents of this series (Four Calculations; the Metrics of the Living Spaces; the Allgemeine Feldtheorie, caveats (ii) and (xi); war diary and scripts, Cosmology folder). (*Citations from memory; the literature-verification pass applies.*)