The Crawl and the Count
Where G Actually Hides

Open Run (i) Closed; the Two Clocks and Their Hinge; and Why α, b_0 and Newton's Constant Are One Debt With One Number

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Abstract

This note completes the condensed-space arc and then follows it to the place it was always pointing. Three results and one diagnosis. First, open run (i) of The Delay That Makes G is closed. The infall delay diverges logarithmically at the horizon, and the note asked for a finite inner cutoff; in fact both ends diverge, and this corpus already owns both cutoffs, because the Floors note named them. Taking the winding floor as the inner limit and the Schwarzschild floor as the outer gives $\Delta t = \tau_s \cdot \ln(r_s/\bar{\lambda}_C) = 2\cdot\tau_s\cdot\ln(M/M_\times)$, a finite self-delay equal to the horizon crossing-time times the number of e-folds between an object's two floors — and it vanishes exactly at $M_\times = m_{Planck}/\sqrt{2}$, the hinge the Floors note already identified. The cutoff was not imported; it is the other floor. Second, the two response times satisfy $t_C/\tau_s = (M_\times/M)^2$ exactly, so the quantum clock and the gravitational clock cross at that same hinge. For an electron the gravitational field answers 2.85×10^{44} times faster than the winding: the whip has no lag at that scale, and what resists when the cube is pushed is the winding, not the field. Third, the mass-dependence of the delay is located: $\Delta t = \tau_s \times N_{efold}$, where N_{efold} varies by a factor of six across sixty orders of magnitude of mass while $\tau_s = 2GM/c^3$ carries everything and is linear in M. The crawl is nearly the same depth for everything; the price per e-fold is the mass. Then the diagnosis. Three routes in this corpus reach Newton's constant and all three are closed loops; taking c, ħ and H as measured, G is fixed by one dimensionless number, the ladder depth $N = \ln(R_H/\ell_P) = 140.294$, and read through Bekenstein's counting that number is a bit count: $G = \pi c^5/(\hbar H^2 N_{pix})$ with $N_{pix} = 2.2654\times10^{122}$. So G does follow from the Hubble radius, the moment one can say how many bits the horizon holds. What is missing is a scale — and P1, P2 and P3 are all scale-free, so the postulates forbid themselves one. The only mechanism physics knows for manufacturing a length from a dimensionless coupling is dimensional transmutation, which requires a running coefficient b_0 this corpus has already deferred. Hence caveat (iv), caveat (v) and the G problem are not three debts but one, and it is b_0. Every flag flown.

1. Where the Arc Stood

The condensed-space programme has two halves and they were in very different states. The energy half is done: The Delay That Makes G §2 integrates the self-field inward and stops at the horizon rather than at infinity, giving $U_{ext}(r_s) = GM^2/2r_s = Mc^2/4$ — a quarter of the rest energy outside the horizon for every mass, independent of M. That section flags its own coefficient properly: the ¼ is a Newtonian heuristic, general relativity permits no clean local energy density for the gravitational field, the Schwarzschild mass already contains the binding energy, and the robust content is only the scale, $U_{ext}(r_s) \sim Mc^2$. Nothing in this note changes that.

The time half was open, and it was the one that diverged. §4 integrates the delay through the infall geometry and finds the logarithm blowing up at r_s — light stalls at the horizon, the Shapiro delay carried to its limit. Open run (i) asked for the finite-cutoff regularization. That is what §2 below supplies.

2. Open Run (i), Closed

The Shapiro excess over flat space, accumulated between two radii, is

$$\Delta t = (r_s/c) \cdot \ln[\,(r_{out} - r_s) / (r_{in} - r_s)\,] \quad (1)$$

First observation, and §4 of the earlier note missed it: both ends diverge logarithmically. The inner divergence as $r_{in} \to r_s$ is the one named; there is an outer one as well, and a finite answer needs two cutoffs, not one.

Second observation, and this is the point: the corpus already owns both, because The Floors of Condensation named them. The winding floor $ƛ_C = \hbar/Mc$ falls as mass grows; the Schwarzschild floor $r_s = 2GM/c^2$ rises. Take the inner cutoff to be the winding floor and the outer scale to be the horizon itself, and (1) becomes

$$\Delta t \;=\; \tau_s \cdot \ln(\, r_s \,/\, ƛ_C \,) \;=\; 2\cdot\tau_s\cdot\ln(\, M \,/\, M_\times \,)\,, \quad M_\times = \sqrt{\hbar c/2G} \quad (2)$$

The self-delay is the horizon crossing-time multiplied by the number of e-folds between the object's two floors. And it vanishes exactly at $M_\times = m_{Planck}/\sqrt{2} = 1.539\times10^{-8}$ kg — the hinge the Floors note derived as the single crossing of the two floors. The regularization did not have to be invented: the cutoff is the other floor, and the two notes close on each other.

Below the hinge the formula reports a negative logarithm, and that is a domain statement rather than a failure. For $M < M_\times$ the winding floor lies outside the horizon, so there is no region between the floors and no path to the Schwarzschild radius at all. Nothing to integrate. It is the Floors note's hand-over, read as a time.

The outer cutoff is a choice, and it is flagged at the same standard as the ¼ of §2. Setting $r_{out} - r_s = r_s$ is natural because it is the other floor, but a different outer scale shifts Δt by an additive $\tau_s\cdot\ln(\text{ratio})$. The robust content is the structure — a two-floor logarithm — not the additive constant.

3. Two Clocks, and They Cross at the Same Hinge

Divide the two floors by c and they become times. The quantum response — the winding answering — is $t_C = ƛ_C/c = \hbar/Mc^2$. The gravitational response — the field answering — is $\tau_s = r_s/c = 2GM/c^3$. Their ratio is exact:

$$t_C / \tau_s = ƛ_C / r_s = (M_\times / M)^2 \quad (3)$$

So the two clocks cross where the two floors cross, at $M_\times$. Below the hinge the winding answers first; above it, the field. The Floors note said this with lengths; (3) says it with times, and the arithmetic is the same arithmetic.

This locates the delay law's domain precisely. $G = c^3\tau_s/2M$ is a statement about the gravitational floor, and it describes the dominant inertia only above $M_\times$. All particles, all chemistry, all life sit below the hinge — on the winding floor, as the Floors note says — and for them the delay law is a correction of order $(M/M_\times)^2$, not the mechanism.

4. The Whip at the Electron: the Far End Answers First

Put an electron in a cube and push the cube. The condensed-space picture says: the field must readjust, the readjustment propagates at c, the lag is the resistance — a whip whose far end is the field. Run the numbers and the whip inverts.

The electron's winding answers in $t_C = 1.288\times10^{-21}$ s. Its gravitational field answers in $\tau_s = 4.513\times10^{-66}$ s. The field is faster by 2.854×10^{44}, which by (3) is exactly $(M_\times/m_e)^2$. The whip has essentially no length: its far end is 10^{-57} metres away and reports back forty-four orders of magnitude before the near end has moved.

The reason is geometric and worth stating plainly. The crawl to the electron's horizon is long in scale — 102.4 e-folds below its own Compton cell, past the Planck length and fifty-one e-folds beyond — but short in time, precisely because the horizon is minuscule. Depth in e-folds and duration in seconds are different quantities, and at the electron they point opposite ways.

So the honest reading: at electron scale what resists is the winding, not the field. The condensed-space account of inertia is correct in structure and belongs to the gravitational floor; below the hinge the quantum guardian holds the whip.

5. Where the Mass Dependence Actually Lives

Equation (2) also answers a question §3 of the earlier note left as an assertion — why the delay tracks inertia. The Shapiro delay accrues at one horizon-crossing-time per e-fold, so $\Delta t = \tau_s \times N_{efold}$, and the two factors behave completely differently across the ladder. For a human $N_{efold} = 44.5$; for the Earth 150.1; for the Sun 175.5; for Sagittarius A* 206.1; for the universe 279.9. That is a factor of six across sixty orders of magnitude of mass. Meanwhile $\tau_s = 2GM/c^3$ varies by those sixty orders and is exactly linear in M.

So $\Delta t \approx$ (a number near a hundred to three hundred) × $2GM/c^3$ — linear in mass, which is the scaling inertia demands. The crawl is nearly the same depth for everything; the price per e-fold is the mass. That is a sharper account than a single characteristic crossing-time, and it comes out of the same integral.

One entry is not fitted but forced. For the universe, saturation gives $r_s = R_H$, whence $r_s/\bar{\lambda}_C = ½(R_H/\ell_P)^2$ identically, so $N_{efold} = 2\cdot\ln(R_H/\ell_P) - \ln 2 = 279.895$. The corpus's 140.3-e-fold ladder appears here doubled, as an algebraic consequence of the saturation condition.

6. The Circularity, Mapped

With the delay law regularized, it is worth asking what it and its siblings actually deliver. Three routes in this corpus reach Newton's constant, and all three are closed loops.

Sciama and Mach: $GM/Rc^2 = ½$ gives $G = Rc^2/2M$ — but $M = (4/3)\pi R^3\rho_{crit}$ and ρ_{crit} is defined as $3H^2/8\pi G$, so G cancels. Curved One Way already flags this as definitional rather than an audit, and correctly.

The engine of Part IV: $\kappa = 2\pi/(\hbar c\cdot\eta)$ with $\eta = 1/4\ell_P^2$ delivers $\kappa = 8\pi G/c^4$ — from the pixel size, and $\ell_P = \sqrt{\hbar G/c^3}$ contains G.

The delay law: $G = c^3\tau_s/2M$ with $\tau_s = 2GM/c^3$. §7 of the earlier note says this in as many words — G is put in to get τ_s out.

None derives G. Each converts G into a different unknown. That is not a criticism of the routes; it is a statement about where the debt actually sits.

7. One Number

Take c, ħ and H as measured. Then G is fixed by exactly one dimensionless number — the ladder depth:

$$N = \ln(R_H / \ell_P) = 140.2942 , \quad G = c^5\cdot e^{-2N} / (\hbar\cdot H^2) \quad (4)$$

which returns 6.674300×10^{-11} against a measured 6.674300×10^{-11}. So deriving G and deriving N are the same sentence, and every relation in §6 is bookkeeping around that single number.

8. The Same Number as a Bit Count

Bekenstein's counting says a horizon carries $A/4\ell_P^2$ entries, one per Planck pixel. Written out for the cosmic horizon:

$$N_{pix} = \pi\cdot R_H^2/\ell_P^2 = \pi\cdot c^5/(\hbar\cdot G\cdot H^2) = 2.2654\times10^{122} , \quad G = \pi\cdot c^5 / (\hbar\cdot H^2\cdot N_{pix}) \quad (5)$$

So the answer to the question this note was asked — does G follow from the Hubble radius — is yes, the moment one can say how many bits the horizon holds. Newton's constant is not a force strength. It is the exchange rate that makes the cosmic horizon hold 2.27×10^{122} entries.

And 'count the seals in their natural pixel' is, word for word, the gearbox conjecture of Allgemeine Feldtheorie §11. So G and α are not two problems. They are one counting problem asked at two radii.

The target carries a tolerance, which makes it well posed rather than aspirational. The Hubble tension alone spreads N by 0.08 between 67.4 and 73.0 km/s/Mpc, so a derivation of N need land only within about ±0.04 of 140.25 — a relative tolerance of 0.03%.

9. What Is Missing: a Scale, and the Postulates Forbid One

Now the diagnosis, and it is structural rather than computational.

P1 is an algebra; quaternions contain no length. P2 gives the family law, and $T\cdot R = \hbar c/2\pi k_B$ is a relation between a temperature and a length, not a length. P3 is a symmetry. All three postulates are scale-free, and The Delay That Makes G §8 celebrates exactly this: an exponential geometry is scale-free, every e-fold looks like every other, which is why one delay law spans eighty decades and the family law holds at every rung.

That reach and this failure are the same property. N counts e-folds. A theory in which every e-fold looks like every other cannot count them. The scale-freedom that lets one law span the ladder is precisely what forbids the ladder an absolute length — and N is nothing but the ladder's length.

So what is missing is not a calculation left undone. It is an ingredient of a kind the postulates do not contain: something that breaks the scale invariance.

10. Dimensional Transmutation, and the Shape It Would Have

Physics knows exactly one mechanism for manufacturing a length out of a dimensionless number. In quantum chromodynamics, $\Lambda = \mu\cdot\exp(-1/(b_0\cdot\alpha_s(\mu)))$: a dimensionless coupling together with a running law produces a scale, and the scale is an exponential of the inverse coupling.

If this framework is ever to produce N, that is the shape it must have — $N \sim \mathrm{const}/\alpha$, not $\mathrm{const} \times \ln(1/\alpha)$. The distinction matters, because §8 of the earlier note currently reads as the second form.

Quarantined, at this series' standard and with the reasons attached: $N\cdot\alpha = 1.0238$, that is, $\ell_P = R_H\cdot\exp(-1/\alpha)$ to 2.4%, which is transmutation's exact form. It sits in the same band as this corpus's other near-misses — 1/2e at 4.4%, the Higgs as first weak harmonic at 3.7%, the geometric-mean anchor at 3.8% — and that band's record is nought for one, the geometric mean having failed its first quantitative test. The form argument is the durable part of this section. The number is not, and it was found in minutes while looking for the form, which is exactly the circumstance in which people convince themselves.

11. Three Debts, One Debt

Dimensional transmutation requires two things: a coupling, and the coefficient governing its running. This corpus owes both, and has been listing them separately.

Caveat (iv) is the gearbox — α underived. Caveat (v) is the logarithm — the running's direction derived from the stabilizer ladder, its coefficient b_0 not. And the deferred list already carries 'the logarithm of the running coupling, b_0 from the seven triples, the State Octonion sequel's burden'. Add to those the G problem of §7: N = 140.29, underived.

These are one debt. α says which coupling; b_0 says how fast it runs; N is the answer the two produce together, and G is N in different clothing. So b_0 is not owed to the strong sector alone, as the deferred list implies. It is owed to gravity, and it is the single outstanding ingredient standing between this framework and Newton's constant.

That is a reclassification, not a result. Nothing here computes b_0. What it does is remove the impression that three separate programmes are pending and replace it with one target, with a number and a tolerance.

12. Corrections to Earlier Notes

Three, small and worth making.

The Delay That Makes G §8 states that the universe is 140.3/4.92 = 28.5 α-compressions deep and calls the intuition 'already half-quantified'. It is not quantified at all: 28.5 is defined as N divided by $\ln(1/\alpha)$, so it carries exactly the information N carries and no more. Writing $N = 28.5 \times \ln(1/\alpha)$ is a change of units, not a decomposition, and becomes a derivation only if something forces the 28.5 independently. The section should say so, because as written it suggests part of the work is done.

The Delay That Makes G §2 states that the electron's gravitational self-energy far from the horizon is about 10^{-44} of its mass. The exact value is $\frac{1}{2}(m/m_P)^2 = 8.76\times10^{-46}$, roughly a hundred times smaller. The argument is unaffected — the point was 'negligible', and it is more negligible than stated.

The Delay That Makes G §4 names one logarithmic divergence in the infall integral. There are two, one at each end (§2 above). The regularization needs two cutoffs, and the corpus supplies both.

13. Status, and What Is Owed

Established: equation (2) and its vanishing at the hinge; equation (3) and the crossing of the two clocks; the location of the mass-dependence in §5; the circularity of all three routes to G; equations (4) and (5), which are algebra; and that the scale-freedom of P1–P3 is incompatible with deriving N.

Conjectured and labelled: that dimensional transmutation is the mechanism, hence that the shape is const/α; and that α, b_0 and G are one debt. The first is an argument from the only known precedent, not a proof that no other mechanism exists. The second follows from the first and inherits its standing.

Quarantined: N·α = 1.0238.

Owed: b_0. And, at the smaller scale, a principled outer cutoff for (1) rather than the natural one, and whatever would rescue §2's ¼ from being a Newtonian heuristic.

On authorship, at this series' first rule: computed and drafted by machine (Claude, Anthropic) from the author's question — how does G follow out of geometry, out of the Hubble radius. It is a walkthrough to be checked. Equations (4) and (5) take a calculator; equation (2) takes an integral table.

14. The Sentence

The crawl to the Schwarzschild radius is a hundred e-folds deep and lasts almost no time at all, because depth and duration are different quantities and at the electron they point opposite ways — so the whip that was supposed to make inertia has its far end reporting back forty-four orders of magnitude too early, and the resistance belongs to the winding; and following the same delay law upward to where it does hold, and then asking what it delivers, one arrives at a single number, the ladder's own length, which is Newton's constant wearing a count of horizon bits, and which this framework cannot produce because every one of its postulates is scale-free and a theory in which each e-fold looks like the last cannot say how many there are — leaving one ingredient outstanding, the running coefficient that turns a pure number into a length, already on the deferred list under another sector's name.

References

The papers and notes of this series (The Delay That Makes G — §2 the self-field energy, §4 the divergent integral, §7 the load-bearing honesty, §8 the exponential zoom, open run (i); The Floors of Condensation — the two floors and their crossing at m_Planck/√2; the Allgemeine Feldtheorie — P1–P3, Part IV the engine, §11 the gearbox, caveats (iv) and (v), the deferred list; Curved One Way — $GM/Rc^2 = ½$ as definitional; The Core of Metric D; Tolman from Staticity; the Information Science note — Landauer and the door). J. D. Bekenstein, Phys. Rev. D 7, 2333 (1973); S. W. Hawking (1975); D. W. Sciama, Mon. Not. R.

Astron. Soc. 113, 34 (1953); E. Mach; I. I. Shapiro, Phys. Rev. Lett. 13, 789 (1964); S. Coleman and E. Weinberg, Phys. Rev. D 7, 1888 (1973) — dimensional transmutation. Verification script: Cosmology/crawl_and_count_check.py. (Citations from memory; the literature-verification pass applies to every one.)

Acknowledgment: the question — how does G follow out of geometry, out of the Hubble radius — and the demand that followed it, what is missing, are the author's. Computation and drafting by machine (Claude, Anthropic).