The Recursion Unit: Seconds at the Electron Scale

The Slip Cadence of the Fine-Structure Chain in Seconds, from the Electron Closure, the Trapping Condition and the Medium's Rate

Dexter Alan Gilbert
Independent Researcher, Kingsport, Tennessee · ORCID 0009-0003-8489-3933
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Abstract

The Cohesion UFT series expresses its timing in recursion units. The torsion slope of the electromagnetic recursion is $g = 6\kappa_6\bar{I}^{3/2} = 0.0041775$ per unit with the recursion rate normalised to $\omega = 1$, the slip cadence is $t_{coh} = 2/g = 478.75$ units, and the restart rate is g^2/ω; every quantity of the fine-structure chain is a ratio and needs no unit, but attaching seconds to the cadence does, and the record has carried the unit's value as open, fixed only by dimensional analysis through the Compton frequency and left between two readings, $2/\omega_C = 2.58 \times 10^{-21}$ s and $2/(g\omega_C) = 6.17 \times 10^{-19}$ s. This note closes the row from two closures already in the record. The electron closure of $E = pr$ fixes the recursion length at the reduced Compton length λ_C with unit coefficient; the trapping condition fixes the rest energy at $\hbar\omega_C$; and the medium's rate c relates the two, $\omega_C = c/\lambda_C$. The recursion unit at the electron scale is the time in which a rotation of radius λ_C advances one radian at the medium's rate: $u_e = \lambda_C/c = \hbar/(m_e c^2) = 1.2881 \times 10^{-21}$ s. The two readings are then not two values of one quantity but two counts of one unit, and the record has already chosen between them: the two-unit count is the superseded $2/\omega$ form of the cadence, and the $2/g$ count is the coherence interval of the recursion whose slope g is. The cadence of the fine-structure chain is therefore 6.1667×10^{-19} s, a recursion rate of 1.622×10^{18} per second, 76.2 turns of the recursion per slip, with the restart rate 1.052×10^{37} rad/s². The rule the identification instances — the recursion unit of a scale is its coherence length over its propagation rate — returns at the graphene lattice the clock the record identified there independently, a/v_F. The slip energy of the toggle's form, $2\hbar g$ at the electron's rate, becomes a number, $2g \cdot m_e c^2 = \Delta\theta \cdot m_e c^2 = 4.27$ keV, stated as the release of the recursion's own gear-shift with no measurement attached, and not as the switching energy of a device. Standing: the unit identified from two closures of the record; what remains open is the absolute scale of either, the electron mass from the axiom.

1. The Open Row

The textbook states the position in one paragraph of its Chapter 7 [1, §7.4]. The interval $t_{coh} = 2/g$ is stated in recursion units with $\omega = 1$; to attach seconds to it at the electron scale the series takes the Compton angular frequency as the recursion rate, $\omega_C = m_e c^2/\hbar = 7.7634 \times 10^{20}$ s^{-1}; the series calls the result dimensional analysis and not a derivation; and two readings are in the series, $2/\omega_C = 2.58 \times 10^{-21}$ s, which counts the interval as two recursion units, and $2/(g\omega_C) = 6.17 \times 10^{-19}$ s, which counts it as $2/g$ of them. Chapter 10 lists the unit among the four items open around the fine-structure chain, with the remark that the chain does not need it, since every quantity in it is a ratio, but that attaching seconds to t_{coh} does [1, §10.5]. Appendix C carries the row — the recursion unit in seconds, $2/\omega_C$ or $2/(g\omega_C)$,

fixed by the dimensional identification of the unit, resolving the two readings — and Appendix D records that the book adopts neither reading and leaves the unit open [1, App. C, D]. The glossary defines the unit as the duration in which g, t_{coh} and a_r are expressed and says its value in seconds is open. The Research Calculator prints both readings on the forward card of Module 3 and marks them open between [2]. The Methodology page carries the same sentence under structural time [3].

The row is small and it is load-bearing. Structural time is a count of slips (Definition 9.1; Proposition 9.1), scale-free and dimensionless by construction, and the framework needs no seconds to run; but every comparison of a cadence with a clock does, and the applied register's timings — the fluid vortex, the cyclone, the pulsar, the graphene lattice — are posed in seconds [4]. Each of them waits on its own torsion slope, which is Problem 4's function $g(D_{st})$ and Problems 5 and 6 as instances; but a slope in units becomes a time only through the unit, and the unit is what this note fixes. It fixes it from statements the record already makes, which is why the note is short.

2. What Fixes the Unit

Three statements of the record meet at the electron, and the unit is where they meet.

The closure fixes the length. Chapter 4 evaluates $E = pr$ at the electron with the coherence length $\lambda_C = \hbar/(m_e c) = 3.8616 \times 10^{-13}$ m and the recursion volume its cube with coefficient one, $r = \lambda_C^3$; the pressure the identity requires is the natural pressure of the scale, $p = m_e^4 c^5/\hbar^3$, and pr returns $m_e c^2$ with nothing left over [1, Ch. 4; 5; 6]. The closure is exact in its relations and silent on the scale, and the record carries it at that standing. What it fixes for the present purpose is the radius of the recursion: λ_C, with the coefficient one that makes the closure close.

The trapping condition fixes the rate. Chapter 11 states the condition at which a recursion is trapped, $\hbar \cdot (g/\omega_C) = \hbar/2$, the slip angular momentum equal to the intrinsic spin, and reads from it the spin $\hbar/2$ and the rest energy $E_{rest} = \hbar\omega_C$, the recursion slipping at the rate ω_C and that rate identified with the electron's Compton frequency [1, Prop. 11.2; 7]. The series calls the identification self-consistent and the case a closure of the same kind as Chapter 4's. What it fixes for the present purpose is the angular rate of the recursion: $\omega_C = m_e c^2/\hbar$.

The medium's rate relates them. The recursion medium propagates at c; the photon is the recursion that moves at the medium's own rate, and c is a property of the medium rather than a parameter [8; 9; 1, Ch. 14]. A rotation of radius λ_C at the angular rate ω_C has a boundary speed $\lambda_C \omega_C = (\hbar/m_e c)(m_e c^2/\hbar) = c$. The length of the closure and the rate of the trapping condition are therefore one statement read twice: the minimal trapped recursion is the one whose boundary circulates at the medium's own rate, which is why it neither propagates nor collapses, and why its radian time is the reduced Compton length over c.

The recursion unit at the electron scale. $u_e = \lambda_C/c = 1/\omega_C = \hbar/(m_e c^2) = 1.2881 \times 10^{-21}$ s: the time in which the electron-scale recursion advances one radian. One cycle is $2\pi u_e = 8.0933 \times 10^{-21}$ s, the Compton period; the cycle rate is 1.2356×10^{20} per second, the Compton frequency.

This is more than the dimensional analysis the series called it, and less than a derivation, and the standing should be said exactly. Dimensional analysis would admit any rate built from m_e, $\hbar$ and c, with any coefficient. The closure removes the coefficient: $r = \lambda_C^3$ with coefficient one is what returns $m_e c^2$, and a rotation at that radius has the rate ω_C only if its boundary moves at c — a different coefficient in the closure, or a boundary rate other than the medium's, would move the unit, and the record has neither. The trapping condition then returns the same ω_C from the other side, from the spin and not from the length. Two closures of the record, Chapter 4's and Chapter 11's, meet at one rate through the medium's c; the reading that joins them, that the trapped recursion's boundary circulates at the medium's rate, is the identification this note makes, and the standing of the unit is *identified*. What would make it derived is what Appendix C names as the absolute scale of the cascade: m_e from the axiom, which would fix λ_C and ω_C at once and the unit with them [1, App. C]. The unit's standing is the closures' standing, and no number in the fine-structure chain moves.

3. The Two Readings, Reconciled

Both readings in Section 7.4 use the same unit. $2/\omega_C$ is two units; $2/(g\omega_C)$ is $2/g$ units. The question the row leaves open is therefore not which unit but which count, and the record has already answered it. The two-unit count is the form $t_{coh} = 2/\omega$, which Appendix D records as the Version 4 form, arising from equating the two coordinates of the release before the slope was placed between them, and which the Slip Acceleration paper superseded with $t_{coh} = 2/g$, the form the calculator and the textbook use [1, §7.4, App. D; 10]. With the slope placed, the count is $2/g$ for the recursion whose slope g is. For the electromagnetic recursion under the electron field, whose slope the chain derives [12; 18], $g = 0.0041775$ and the count is 478.75 units; in the unit of Section 2 that is

$$t_{coh} = (2/g)\cdot u_e = 478.75 \times 1.2881 \times 10^{-21}\ \text{s} = 6.1667 \times 10^{-19}\ \text{s}.$$

The second reading of Section 7.4 is this number; the first is the superseded count in the same unit. The trapped electron's own recursion is a different case: the trapping condition puts its slope at $g/\omega_C = 1/2$, 120 times the electromagnetic recursion's, a ratio the record already notes is fixed by α and the condition and is not a parameter [1, §11.2], and its interval is correspondingly shorter. The record states the coherence limit of 2 rad for the electromagnetic recursion under the electron field, from $\hbar/(\hbar/2)$, and does not state the limit of the electron's recursion under its own containing field; so this note attaches seconds to the chain's cadence, which is what the row asks, and leaves the trapped recursion's own interval where Chapter 11 leaves it. The row closes: one unit, λ_C/c; one count for the chain, $2/g$; the cadence in seconds as above.

4. The Electron's Timing in Seconds

Every quantity of the chain's clock follows from the unit by multiplication, with the standings it already carries. The inputs are CODATA 2018 for m_e, $\hbar$ and c [11], and the chain's $g = 0.0041775$ [1, Ch. 10; 12]. The two-unit and $2/g$ readings are listed for the record.

Quantity	Value	Standing
Recursion unit $u_e = \lambda_C/c = \hbar/(m_e c^2)$	1.2881×10^{-21} s	Identified from the closure, the trapping condition and the medium's rate
Recursion rate $\omega_C = c/\lambda_C$	7.7634×10^{20} rad/s	The trapping condition's rate; the closure's length over c
Cycle $2\pi u_e$; cycle rate $\omega_C/2\pi$	8.0933×10^{-21} s; 1.2356×10^{20} Hz	The Compton period and frequency
Torsion slope g (per unit, $\omega = 1$)	0.0041775	Derived (Ch. 10), with κ_6 and the bridge stated inside it
Slip operator $\Delta\theta = 2g/\omega$	0.008355 rad = 0.4787°	Derived
Cadence $t_{coh} = 2/g$	478.75 units = 6.1667×10^{-19} s	Derived in units; in seconds through the identified unit
Recursion rate $\nu_r = 1/t_{coh} = g\omega/2$	1.622×10^{18} per second	Proposition 9.1, in seconds
Turns of the recursion per slip, $t_{coh}/2\pi$	76.2	Derived
Restart rate $a_r = g^2/\omega$	1.745×10^{-5} rad per unit² = 1.052×10^{37} rad/s²	Derived in units; in seconds through the unit
Superseded count $2/\omega$, in the same unit	2 units = 2.58×10^{-21} s	The Version 4 form (App. D); not the chain's cadence
Slip energy of the toggle's form, $2\hbar g$ at the electron's rate	$2g \cdot m_e c^2 = \Delta\theta \cdot m_e c^2 = 4.27$ keV	Form derived (Ch. 8, Def. 22.2); the number through the unit; no measurement

The slip energy. Chapter 8 gives the release at the toggle as a quantised emission, $E_{slip} = \hbar\omega \cdot (2g/\omega) = 2\hbar g$ at the scale whose torsion slope is g, and Definition 22.2 carries the same form [1, Ch. 8, §22.4; 16; 17]. At the electron's rate the form is a number: $2\hbar g\omega_C = 2g \cdot \hbar\omega_C = 2g \cdot m_e c^2 = 4.27$ keV, which is the slip operator in radians times the rest energy — the release is $\Delta\theta$ of a cycle whose quantum is $m_e c^2$. The number is stated as what it is: the energy of the electromagnetic recursion's own gear-shift at the electron's clock, with no measurement attached, carried as Chapter 8 carries Φ_t, with the observed column empty. It is not the switching energy of a bit in a device. A bit in a lattice switches at the lattice's slope and the lattice's rate, which is the same form $2\hbar g$ evaluated where the bit runs, and the record derives neither there; that is the content of Problem 6, and the single-electron spin-flip measurements the posed problem will be held against are quantities of the field that holds the reference phase, not of this release. The number above should not be read into that problem.

5. The Rule, and Where It Runs

The identification is an instance of a rule that the record has been using without stating it: the recursion unit of a scale is its coherence length over its propagation rate, $u = \ell_{coh}/v$, the time in which the recursion advances one radian at the rate its medium carries it. At the electron the length is the closure's and the rate is the medium's. At the graphene lattice the record identified a clock without naming the rule: the natural clock $v_F/(2\pi a) = 647$ THz and the coherence interval $2a/v_F = 0.49$ fs from the lattice constant $a = 0.246$ nm and the Fermi velocity $v_F \approx 10^6$ m/s [1, §19.6, §22.4; 13]. That is the rule with the lattice constant as the coherence length and the Fermi velocity as the propagation rate: $u_g = a/v_F = 2.460 \times 10^{-16}$ s, rate 4.065×10^{15} rad/s, cycle rate 647 THz. The interval $2a/v_F$ the record identified there is the two-unit count, the superseded form; the lattice's own count is $2/g_{graphene}$ units, and $g_{graphene}$ is the open quantity of Problem 6 [4]. The rule gives the lattice its unit now and its interval when the slope is derived.

Scale	Coherence length	Propagation rate	Unit $u = \ell_{coh}/v$	The record's clock
Electron	$\lambda_C = 3.8616 \times 10^{-13}$ m (closure)	c	1.2881×10^{-21} s	$\omega_C = m_e c^2/\hbar$ (trapping condition)
Graphene lattice	$a = 0.246$ nm (measured)	$v_F \approx 10^6$ m/s (measured)	2.460×10^{-16} s	$v_F/(2\pi a) = 647$ THz (identified, §19.6)
Fluid vortex	open (Problem 5)	open	open	—

Two things about the rule should be said. It supplies the unit and not the slope: at every scale but the electron the slope g is open, so the rule turns a derived count into seconds where there is a count, and otherwise waits. And it carries the dilation of Chapter 9 with it: the unit is set by the local medium's rate, so where the density of the medium slows the recursion the unit lengthens, which is $d\tau_s/dt \propto 1/D_{st}$ read as a statement about u, and the acceleration term $k_\alpha a$ of that law remains the open quantity it was [1, §9.3, App. C; 14; 15]. Where the coherence length or the rate of a scale is itself open, as both are for the fluid vortex, so is the unit, and the rule says so rather than supplying one.

6. What Moves in the Record

The row. Appendix C's row for the recursion unit closes at the standing identified, with λ_C/c in place of the two readings; Appendix D's entry records that the two readings were two counts of one unit, the first superseded with the $2/\omega$ form; the parameter sheet's row carries 1.2881×10^{-21} s; the glossary's "its value in seconds is open" becomes the identification. Section 7.4 and item four of Section 10.5 are the paragraphs the next version of the textbook revises.

The chain's clock in seconds. $t_{coh} = 6.1667 \times 10^{-19}$ s, $\nu_r = 1.622 \times 10^{18}$ s^{-1} and $a_r = 1.052 \times 10^{37}$ rad/s² enter the parameter sheet beside their values in units. Module 3 of the calculator prints the single reading in place of the two and changes its badge from open to identified; the module's chain is otherwise unchanged, since no ratio in it moves.

The applied register. The graphene clock of Section 19.6 is recorded as an instance of the rule rather than a separate identification; its interval remains open with $g_{graphene}$. The

Methodology page's sentence under structural time, that the recursion unit in seconds at the electron scale is itself open, is replaced by the identification, and the page's standing line for structural time reads: the definition stated; the tick and its monotonicity derived; the unit at the electron identified; the acceleration coupling of the dilation law open [3].

The posed problems. Problems 4, 5 and 6 are posed in seconds and will take them from the rule: the function $g(D_{st})$ of Problem 4 gives a count at each density, and the unit of that scale turns the count into a time [4]. Nothing in the three problems changes; the conversion they would each have needed is now stated once.

7. The Chain and Its Standings

Step	Statement	Standing
Axiom	Pressure exists; ubiquitous, variable, never zero; the recursion medium propagates at c	Axiom; c as the medium's rate stated (Ch. 14)
E = pr at the electron	$r = \lambda_C^3$ with coefficient one; $p = m_e^4 c^5/\hbar^3$; $pr = m_e c^2$	Closure with unit coefficient (Ch. 4)
Trapping condition	$\hbar(g/\omega_C) = \hbar/2$; $E_{rest} = \hbar\omega_C = m_e c^2$	Closure (Prop. 11.2)
The meeting	A rotation of radius λ_C at ω_C has boundary rate c; the trapped recursion's boundary circulates at the medium's rate	Identified (this note)
The unit	$u_e = \lambda_C/c = 1/\omega_C = 1.2881 \times 10^{-21}$ s	Identified; closure-grade in its relations
The count	$t_{coh} = 2/g$, the $2/\omega$ form superseded	Derived (Slip Acceleration; App. D)
The cadence in seconds	$t_{coh} = 6.1667 \times 10^{-19}$ s; $\nu_r = 1.622 \times 10^{18}$ s^{-1}	Derived count × identified unit
The rule	$u = \ell_{coh}/v$ at any scale; the graphene clock returned	Identified; one instance beyond the electron
The slip energy at the electron's rate	$2\hbar g\omega_C = \Delta\theta \cdot m_e c^2 = 4.27$ keV	Form derived; number through the unit; no measurement
Open	m_e from the axiom, which would make the unit derived; k_α in the dilation; g at every scale but the electron	Open (App. C)

8. What the Note Claims

It claims that the recursion unit at the electron scale is $\lambda_C/c = \hbar/(m_e c^2) = 1.2881 \times 10^{-21}$ s, fixed by the electron closure's length, the trapping condition's rate and the medium's rate meeting at one quantity. Standing: identified, from two closures of the record.

It claims that the two readings of the cadence in seconds were two counts of this one unit, that the record had already superseded the two-unit count, and that the cadence of the fine-structure chain is 6.1667×10^{-19} s. Standing: the count derived, the seconds through the identified unit.

It states the rule the identification instances, the coherence length over the propagation rate, and shows it returning the graphene clock the record identified independently.

Standing: identified.

It does not claim a derivation of the unit, which waits on the electron mass from the axiom; a value of the slope at any scale but the electron; or a switching energy for any device. It fits nothing, and no number of the fine-structure chain changes.

9. Conclusion

The series' timing was complete as a count and open as a duration. The duration was in the record all along, in two closures that had not been read together: the length the energy identity fixes at the electron and the rate the trapping condition fixes there are one rotation, at the radius λ_C and the medium's own rate c, and the time of one radian of it is the recursion unit. With the unit the slip cadence of the fine-structure chain is 6.1667×10^{-19} s, 76.2 turns of the recursion per release, and the chain's clock has seconds without a single ratio in it moving. The rule the unit instances gives every scale its clock as soon as its coherence length and its rate are known, and leaves the slope at each scale where the posed problems leave it: to be derived, after which the rule turns the count into a time.

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