

# What $F_{\max}$ Is

The modulus of the omnium: energy is length, mass is time

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Fundamental Density Theory

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## Abstract

In Fundamental Density Theory the ceiling force  $F_{\max} = c^4/4G$  is the modulus of the omnium, and it is the constant the central invariant hides. Energy is length in the ratio  $F_{\max}$  and mass is time in the ratio  $F_{\max}/c$ : every pattern or body has  $E_0 = F_{\max} d_s$  and  $mc = F_{\max} t_s$ , where  $d_s = 2R_s$  is its Schwarzschild diameter and  $t_s = d_s/c$ , and the chain  $E/m = c^2 = (d/t)^2$  is their quotient, with  $F_{\max}$  cancelled. The strand of *What c Is* carries the pairing from rest into motion: over one kept interval  $t_s$  a pattern's  $E$ ,  $pc$  and  $mc^2$  are  $F_{\max}$  times the length its strand runs, the length it advances and the length it circulates. Read at the ceiling tension,  $E^2 = (pc)^2 + (mc^2)^2$  is the strand's right triangle, the four-momentum is  $F_{\max}/c$  times the four-displacement, and in the bivector reading  $\mathbf{P} = F_{\max} \mathbf{D}$ . The modulus enters three laws linearly, the rest energy of a pattern or body (core 0.2), the pair force of I-1 and the field equations,  $T_{\mu\nu} = (F_{\max}/2\pi) G_{\mu\nu}$  with  $F_{\max} = 2\pi/\kappa$  (I-4); it bounds a fourth, the closure, whose tension equals its strand's energy per unit length, so that  $c^2$  is tension over inertia per unit length. Against the Planck quantum the pairing meets its inverse:  $2R_s \bar{\lambda}_C = \hbar c/F_{\max} = d_{\min}^2$  for every pattern or body, with  $\bar{\lambda}_C$  the reduced Compton length. The floor length is the geometric mean of the gravitational diameter and the quantum length, and exactly one of the two lies above it. A closed pattern's run per radian of kept phase is a one-action stroke of 0.1a with force fraction  $b = 2R_s/\bar{\lambda}_C$ ; bounded by the floor, it keeps  $\bar{\lambda}_C$  above  $d_{\min}$  and the rest energy below  $E_{\text{floor}} = F_{\max} d_{\min}$ . As a pattern approaches the floor, the closure tension of its braid, summed over strands that close once per kept period, tends to  $F_{\max}/2\pi = 1/\kappa$ . A receipt script checks the displayed identities and numbers: 39/39 pass.

## 1 The constant the chain hides

The central invariant of FDT,

$$\frac{E}{m} = c^2 = \frac{1}{\varepsilon_0 \mu_0} = \left(\frac{d}{t}\right)^2, \quad (1)$$

is one identity read four ways (core 0.1, 0.1a). *What c Is* derived its constant as the strand rate of the omnium: the rate of every stroke measured on the spot, which converts the time a pattern keeps into the length its strand runs and, squared, the matter reading of the one substance into its energy reading [1] (core 0.1d).

Read numerator to numerator,  $E/m = d^2/t^2$  pairs energy with a squared length and mass with a squared time, and the factor of that pairing,  $E/d^2 = m/t^2$ , a force per length, differs from pattern to pattern. Taking one factor of length into the constant leaves a pairing that is linear, exact and

the same for every pattern and body. Its constant is the ceiling force of core 0.2,

$$F_{\max} = \frac{c^4}{4G} = 3.0256 \times 10^{43} \text{ N.} \quad (2)$$

Every pattern or body has  $E_0 = F_{\max} d_s$  and  $mc = F_{\max} t_s$ , with  $d_s$  its Schwarzschild diameter and  $t_s = d_s/c$ : one equation, read in length and in time. Their quotient is (1), with  $F_{\max}$  cancelled (§3).

$F_{\max}$  is the modulus of the omnium. The omnium is an elastic medium (P-2), and  $F_{\max}$  is the constant through which its geometry becomes its mechanics, linearly in each case, which is Hooke's form: a length into energy, a product of two curvature ratios into force, a curvature into stress. It also bounds the tension that holds every closed pattern.  $G$  is not a constant of its own:  $G = c^4/4F_{\max}$ , I-4 writes Einstein's coupling as  $\kappa = 2\pi/F_{\max}$ , and core 0.2 writes the Schwarzschild radius as  $R_s = \mathcal{M}c^2/(2F_{\max})$ , which needs no numerical  $G$ . The sections that follow carry the pairing from rest into motion through the strand of *What c Is* (§4), find the modulus in three laws and the bound of a fourth (§5), and meet the pairing's inverse at the floor, where the quantum enters (§6). Section 7 collects the constants that carry the conversions: one rate, one modulus, one quantum. The receipt script of Appendix A checks the displayed identities and numbers; check labels appear in brackets, [F01a].

## 2 Premises, charts and symbols

The derivation uses the locked core v6.1 [2] and the results of *What c Is* [1], cited by proposition.

- (Q1) *The chain and its rate.*  $E/m = c^2 = 1/(\varepsilon_0\mu_0) = (d/t)^2$  (0.1).  $c$  is the strand rate: every stroke runs at  $c$  measured on the spot, and the two responses give  $c^2 = 1/(\varepsilon_0\mu_0)$  (0.1d; [1], Props. 1–3 and Thm. 1).
- (Q2) *The constants.*  $F_{\max} = c^4/4G$ , never reached;  $\kappa = 8\pi G/c^4$ , the Einstein coupling, with  $\kappa F_{\max} = 2\pi$  exactly;  $R_s = 2GM/c^2 = \mathcal{M}c^2/(2F_{\max})$  for the total gravitating energy  $\mathcal{M}$ , the invariant mass read from the exterior solution, the same in every frame (0.2, 0.5).
- (Q3) *The strand.* A closed pattern moving at  $v$  runs its strand at  $c$  on a helix, translating  $v$  and circulating  $u = c/\gamma$ , and keeps time by circulating,  $cd\tau = udt$  (0.1d; [1], Props. 4–5). A stationary closed pattern, closure included, has  $E = \gamma E_0$ ,  $p = \gamma v E_0/c^2$  and  $m = E_0/c^2$ , and its  $\mathcal{M}c^2$  is  $E_0$  (0.1d, 0.5; [1], Prop. 11, after von Laue [3]). Its energy spinor is  $\mathbf{P} = (E/c)\mathbf{w} = pc + mc^2\mathbf{\Sigma}$ , where  $\mathbf{w} = v + u\mathbf{\Sigma}$  is the strand spinor of the unrolled strand plane and  $\mathbf{\Sigma} = \mathbf{e}_{\parallel}\mathbf{e}_{\perp}$  (0.1d; [1], Props. 13–14).
- (Q4) *The closure.* The closure carries no rate other than the stroke's (I-2, I-5), and a stroke carries momentum  $1/c$  per unit energy (I-2; [1], Prop. 9). A ring of circulating strands of energy  $E_s$  and radius  $R$  is held by the tension  $E_s/(2\pi R)$ , whose stress cancels the strands' integrated stress ([1], proof of Prop. 11).
- (Q5) *The pair law.*  $F = F_{\max} \alpha_1 \alpha_2$  with exterior inputs  $\alpha_i = R_{s,i}/r$  at separation  $r$  (I-1's  $d$ ) on two nonoverlapping spherical supports; exact in model on that domain (I-4, L1);  $F < F_{\max}$ , and  $F \leq F_{\max}/4$  on the pair domain (I-1, I-6).
- (Q6) *The field equations.*  $G_{\mu\nu} = \kappa T_{\mu\nu}$  (I-3), with the Newtonian form returned in the weak-field slow-motion limit (I-4, L2).

- (Q7) *The floor and the quantum.*  $F_{\max} d_{\min} t_{\min} = \hbar$  with  $d_{\min} = c t_{\min}$ ;  $E_{\text{floor}} \equiv F_{\max} d_{\min}$  and  $E_{\text{floor}} t_{\min} = \hbar$ . Because  $F_{\max}$  is never reached, the floor is the infimum of physical strokes, approached by the least closed pattern and occupied by none, and a one-action stroke under a mean force fraction  $b < 1$  of the ceiling has length  $d_{\min}/\sqrt{b}$  and duration  $t_{\min}/\sqrt{b}$ . A pattern of rest energy  $E_0$  keeps the period  $T_q = \hbar/E_0$ , and its strand runs  $\ell_q = cT_q$  in it (0.1a).
- (Q8) *The run per radian.* A closed pattern's strand is stroke (I-5), and the phase it carries is its circulation (I-4; [1], §6): per radian of kept phase, in the time  $1/\omega_q$  with  $\omega_q = E_0/\hbar = 2\pi/T_q$  (I-5), the strand runs  $c/\omega_q = \hbar c/E_0$  with action  $E_0/\omega_q = \hbar$  (0.1a). This run is one physical stroke of action  $\hbar$ , and the floor bounds it (0.1a).

**Charts.** One density coordinate appears: the exterior inputs  $\alpha_i = R_{s,i}/r$  of I-1 (0.3; A-1 of 0.4, exterior branch  $\sigma = +1$ ), in (Q5), the symbol table, Proposition 5, the I-4 row of the invariant table and checks F05a–c. The lengths  $d_s$  and  $\bar{\lambda}_C$ , the force fraction  $b$  and the tensions are not  $\alpha$ 's. In particular  $b = 2R_s/\bar{\lambda}_C$  (§6) is the force fraction of 0.1a for a pattern's own one-action stroke, not the bounded map of 0.4, and it evaluates no field radius.

| symbol                                       | meaning                                                                                                                                                                                                     |
|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $F_{\max}; \kappa$                           | ceiling force $c^4/4G$ (0.2), never reached, the modulus of the omnium; Einstein coupling $8\pi G/c^4 = 2\pi/F_{\max}$                                                                                      |
| $\mathcal{M}; R_s$                           | total gravitating energy, in mass units (0.5); Schwarzschild radius $2G\mathcal{M}/c^2 = \mathcal{M}c^2/(2F_{\max})$ (0.2)                                                                                  |
| $E_0, m; E, p$                               | rest energy $\mathcal{M}c^2$ of a pattern or body, and its mass $E_0/c^2$ ; its energy $\gamma E_0$ and momentum for the bookkeeper                                                                         |
| $d_s, t_s$                                   | Schwarzschild diameter $2R_s = E_0/F_{\max}$ ; $t_s = d_s/c$                                                                                                                                                |
| $v, u; \beta, \gamma$                        | translation and circulation rates of the strand, $v^2 + u^2 = c^2$ ; $\beta = v/c$ , $\gamma = (1 - \beta^2)^{-1/2}$                                                                                        |
| $\Delta\tau; \Delta t$                       | kept interval, $t_s$ in §4; the bookkeeper's interval, $\Delta t = \gamma\Delta\tau$                                                                                                                        |
| $d, x, c\Delta\tau; \vartheta$               | length the strand runs, advances and circulates over $\Delta\tau$ ; its pitch angle, $\cos \vartheta = v/c$                                                                                                 |
| $\Sigma; \mathbf{w}, \mathbf{P}, \mathbf{D}$ | unit bivector $\mathbf{e}_{\parallel}\mathbf{e}_{\perp}$ of the strand plane, $\Sigma^2 = -1$ ; strand spinor $v + u\Sigma$ ; energy spinor $pc + mc^2\Sigma$ ; displacement spinor $x + c\Delta\tau\Sigma$ |
| $F; r, r'; \alpha_i; U$                      | pair force; separation and integration variable; exterior I-1 inputs $R_{s,i}/r$ ; pair energy                                                                                                              |
| $\Phi, \rho$                                 | Newtonian potential and mass density of the static weak field                                                                                                                                               |
| $k; L$                                       | curvature of a strand; its length                                                                                                                                                                           |
| $e_{\ell}, m_{\ell}; \mathcal{T}$            | energy and inertia per unit length of a strand; closure tension                                                                                                                                             |
| $E_s, R$                                     | energy and radius of a ring of circulating strands (Q4)                                                                                                                                                     |
| $\varepsilon_0, \mu_0; V, S$                 | the two responses, $\varepsilon_0\mu_0 = 1/c^2$ ; velocity and strain of a string (Remark, §5)                                                                                                              |
| $\omega, k_x$                                | angular frequency and wavenumber of a plane wave (check F08b)                                                                                                                                               |
| $d_{\min}, t_{\min}; E_{\text{floor}}$       | floor length and time, $d_{\min} = c t_{\min}$ , $F_{\max} d_{\min} t_{\min} = \hbar$ ; floor energy $F_{\max} d_{\min}$ (0.1a)                                                                             |
| $\bar{\lambda}_C$                            | reduced Compton length $\hbar c/E_0 = \hbar/(mc)$ ; for a closed pattern, a run of the strand (I-5)                                                                                                         |
| $T_q, \omega_q; \ell_q$                      | kept period $\hbar/E_0$ and angular frequency $E_0/\hbar$ ; strand run per kept period, $cT_q$ (0.1a)                                                                                                       |
| $F_q, b$                                     | mean force $E_0/\bar{\lambda}_C$ of a pattern's one-action stroke; force fraction $F_q/F_{\max}$                                                                                                            |
| $n; \mathcal{T}_{\text{br}}$                 | helix count of a braid, $n \geq 2$ (I-5); the braid's closure tension summed over its strands                                                                                                               |

### 3 Energy is length, mass is time

**Proposition 1** (The ceiling pairing). *Every pattern or body, of rest energy  $E_0 \equiv \mathcal{M}c^2 = mc^2$ , has*

$$E_0 = F_{\max} d_s, \quad mc = F_{\max} t_s, \quad d_s = 2R_s, \quad t_s = \frac{d_s}{c}. \quad (3)$$

Divided by its own Schwarzschild diameter, or by the time the strand rate takes to cover it, every pattern or body gives the ceiling's linear density, power and mass rate:

$$\frac{m}{d_s} = \frac{F_{\max}}{c^2}, \quad \frac{E_0}{t_s} = F_{\max}c, \quad \frac{m}{t_s} = \frac{F_{\max}}{c}. \quad (4)$$

[F01a, F01b]

*Proof.* Core 0.2 gives  $2R_s = mc^2/F_{\max}$  (Q2); divide by  $c$  for the second equation and by  $d_s$  or  $t_s$  for (4).  $\square$

$E_0$  is  $F_{\max}$  times a length, and  $mc$ , the time component of the pattern's four-momentum at rest (Corollary 2), is  $F_{\max}$  times a time: the form of a work and of an impulse at the ceiling force, which no pattern reaches. Energy is length in the ratio  $F_{\max}$  and mass is time in the ratio  $F_{\max}/c$ , the same for every pattern and body because  $F_{\max}$  is a constant of the medium. One joule is  $3.3051 \times 10^{-44}$  m of Schwarzschild diameter, and one kilogram is  $9.9084 \times 10^{-36}$  s and  $2.9705 \times 10^{-27}$  m. [F13c] The ceiling's values are  $F_{\max}/c^2 = 3.3665 \times 10^{26}$  kg m<sup>-1</sup>,  $F_{\max}c = 9.0706 \times 10^{51}$  W and  $F_{\max}/c = 1.0092 \times 10^{35}$  kg s<sup>-1</sup>. [F13a]

**Corollary 1** (Ceiling units). *In units with  $F_{\max} = c = 1$ , (3) reads  $E_0 = d_s$  and  $m = t_s$ : energy is length and mass is time with no factor left. In these units  $G = 1/4$  and  $\hbar = d_{\min}^2$ . [F02b]*

**Proposition 2** (The chain read through the pairing).

$$\frac{E_0}{m} = \frac{F_{\max} d_s}{F_{\max} t_s / c} = c \frac{d_s}{t_s} = \left( \frac{d_s}{t_s} \right)^2. \quad (5)$$

$F_{\max}$  cancels. The square in  $(d/t)^2$  is two equal factors: the quotient  $E_0/(mc) = d_s/t_s$  of the two readings, and the  $c$  that turns  $m$  into  $mc$ . Both are the strand rate ([1], Thm. 1). The squared pairing of the chain's ratio has the factor  $E_0/d_s^2 = m/t_s^2 = F_{\max}/d_s$ , a force per length that differs from pattern to pattern. [F02a]

*Proof.* The second equation of (3) is the first divided by  $c$ , with  $t_s \equiv d_s/c$ ; their quotient is (5), which is (1) with  $F_{\max}$  cancelled.  $\square$

For any force  $F$  the pair  $(E_0/F, mc/F)$  lies on the stroke line  $d = ct$ , because  $E_0/(mc) = c$ . [F02a] The chain fixes the line and not the point on it. The ceiling force fixes the point, by one constant for every pattern, and that is what the ratio form gives up.

## 4 The energy triangle read at the ceiling tension

**Proposition 3** (The energy triangle). *Let a closed pattern of mass  $m$  move at  $v = \beta c$ . Over the kept interval  $\Delta\tau = t_s$  its strand runs, advances and circulates*

$$d = c \Delta t = \gamma d_s, \quad x = v \Delta t = \beta \gamma d_s, \quad c \Delta\tau = u \Delta t = d_s, \quad (6)$$

with  $\Delta t = \gamma \Delta\tau$ , and

$$E = F_{\max} d, \quad pc = F_{\max} x, \quad mc^2 = F_{\max} c \Delta\tau. \quad (7)$$

*Read at the ceiling tension, the energy-momentum relation is the strand's right triangle:*

$$d^2 = x^2 + (c \Delta\tau)^2 \iff E^2 = (pc)^2 + (mc^2)^2. \quad (8)$$

The run  $d = E/F_{\max}$  is the bookkeeper's energy in ceiling units; the circulated length  $c \Delta\tau = d_s$  is the Schwarzschild diameter of the rest energy, the same at every speed. [F03a-c]

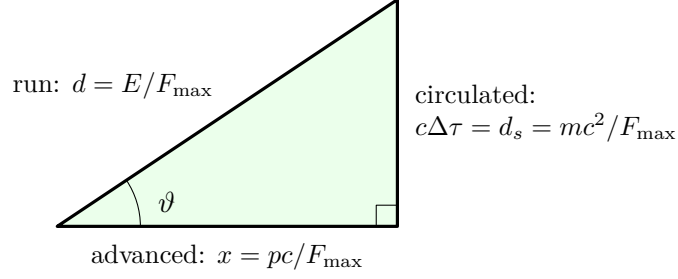


Figure 1: The energy triangle read at the ceiling tension. Over the kept interval  $t_s = 2R_s/c$  the strand runs  $d$  (the hypotenuse), advances  $x$  along its axis and circulates  $c\Delta\tau = 2R_s$  around it;  $F_{\max}$  times the three sides are  $E$ ,  $pc$  and  $mc^2$ . The pitch angle  $\vartheta$  is the strand's,  $\cos \vartheta = v/c$  ([1], Prop. 4). Drawn at  $v : u = 3 : 2$ .

*Proof.*  $c d\tau = u dt$  and  $u = c/\gamma$  (Q3) give (6). With  $E = \gamma mc^2$  and  $p = \gamma mv$  (Q3) and  $mc^2 = F_{\max} d_s$  (Proposition 1),  $E = \gamma F_{\max} d_s = F_{\max} d$ ,  $pc = \beta \gamma F_{\max} d_s = F_{\max} x$  and  $mc^2 = F_{\max} c\Delta\tau$ . The left side of (8) is Pythagoras on the unrolled cylinder ([1], Prop. 5); multiplied by  $F_{\max}^2$  it is the right side.  $\square$

What  $c$  Is read time as circulated strand and space as translated strand. The ceiling force reads energy as strand length:  $E$ ,  $pc$  and  $mc^2$  are  $F_{\max}$  times the length the strand runs, the length it translates and the length it circulates (Figure 1). The legs scale with the interval and the factor scales inversely;  $t_s$  is the interval at which the factor is the ceiling force for every pattern. For a closed pattern  $t_s$  lies below  $t_{\min}$  (Proposition 10), so the triangle read at the ceiling tension is a reading of the strand at every scale, not a stroke of length  $d_s$ .

**Corollary 2** (The four-momentum is a displacement). *With  $\Delta x^\mu = (c\Delta t, \Delta \mathbf{x})$  the pattern's four-displacement over the kept interval  $t_s$ ,*

$$p^\mu = \frac{F_{\max}}{c} \Delta x^\mu. \quad (9)$$

$F_{\max}/c$  is the same in every frame and  $\Delta x^\mu$  over a fixed kept interval is a four-vector, so (9) holds in every frame: it is  $p^\mu = m dx^\mu/d\tau$  with  $m/t_s = F_{\max}/c$ . [F03d]

**Corollary 3** (The open stroke). *An open stroke keeps no time (I-2):  $c\Delta\tau = 0$ , and the triangle closes on its run,  $E = pc = F_{\max} d$  with  $d = x = E/F_{\max}$ . This is the ceiling reading of its run, which no stroke attains; below  $E_{\text{floor}}$  it also lies under  $d_{\min}$ . [F03e]*

**Proposition 4** (The displacement spinor). *In the strand plane of What  $c$  Is, the displacement spinor over the kept interval is*

$$\mathbf{D} \equiv x + c\Delta\tau \Sigma = \Delta t \mathbf{w}, \quad \mathbf{D}\tilde{\mathbf{D}} = d^2, \quad (10)$$

and the energy spinor is

$$\mathbf{P} = F_{\max} \mathbf{D}, \quad \mathbf{P}\tilde{\mathbf{P}} = E^2. \quad (11)$$

The momentum term  $pc$  is  $F_{\max}$  times the translated grade, and the rest energy  $F_{\max}$  times the circulated grade. A pattern at rest has  $\mathbf{P} = F_{\max} d_s \Sigma$ : its rest energy is the ceiling force times the length it circulates in  $t_s$ , a pure bivector. [F04a, F04b]

*Proof.*  $\mathbf{D} = v\Delta t + u\Delta t \Sigma = \Delta t \mathbf{w}$ , and  $\mathbf{D}\tilde{\mathbf{D}} = (v^2 + u^2)\Delta t^2 = d^2$ . By (Q3)  $\mathbf{P} = (E/c)\mathbf{w}$ , and  $E/c = F_{\max}\Delta t$  by (7).  $\square$

## 5 One modulus

Hooke's law makes a load linear in a geometric quantity, and its constant is a modulus.  $F_{\max}$  is the modulus in three laws and the bound of a fourth. The first law is Proposition 1:  $E_0 = F_{\max} \cdot 2R_s$ , the rest energy linear in a length.

**Proposition 5** (The pair force is the modulus times two shares). *On the domain of I-1, for two bodies at separation  $r$ , write  $E_{0,i} \equiv \mathcal{M}_i c^2$ . Each exterior input is*

$$\alpha_i = \frac{R_{s,i}}{r} = \frac{E_{0,i}}{2F_{\max} r} = \frac{2R_{s,i}}{2r}, \quad (12)$$

*the ratio of the body's Schwarzschild diameter to the diameter of the sphere of radius  $r$ , and*

$$F = F_{\max} \alpha_1 \alpha_2 = \frac{E_{0,1} E_{0,2}}{4F_{\max} r^2} = \frac{G\mathcal{M}_1 \mathcal{M}_2}{r^2}. \quad (13)$$

*The force is linear in each share,  $F = (F_{\max} \alpha_2) \alpha_1$ : the share of one body times the force scale  $F_{\max} \alpha_2$  that the other sets. The pair energy is the force times the separation,*

$$U(r) = - \int_r^\infty F dr' = -F_{\max} \alpha_1 \alpha_2 r = -\frac{E_{0,1} E_{0,2}}{4F_{\max} r}, \quad \frac{\partial U}{\partial r} = F, \quad (14)$$

*with  $F$  the attraction's magnitude. [F05a, F05c] The shares lie in the open interval of I-6, and on the pair domain  $F \leq F_{\max}/4$ , with equality only at equal saturated supports in contact. [F05b] By I-4, (13) is Newton's law exactly in model on the pair domain (L1), and  $F_{\max} \alpha_1 \alpha_2 = (2\pi/\kappa) \alpha_1 \alpha_2$  is its Einstein face.*

*Proof.* Substitute  $R_{s,i} = E_{0,i}/(2F_{\max})$  (Q2) into (Q5), and integrate.  $\square$

**Proposition 6** (The field equations with modulus  $F_{\max}/2\pi$ ). *With  $\kappa F_{\max} = 2\pi$  (Q2; I-4),  $G_{\mu\nu} = \kappa T_{\mu\nu}$  reads*

$$T_{\mu\nu} = \frac{F_{\max}}{2\pi} G_{\mu\nu} : \quad (15)$$

*stress is linear in curvature with the modulus  $F_{\max}/2\pi$ , and  $\kappa = 2\pi/F_{\max}$  is the compliance. On a pattern the compliance turns rest energy into length,  $\kappa E_0/2\pi = 2R_s$ . In a static weak field, at leading order (I-4, L2), the metric  $-(1+2\Phi/c^2) c^2 dt^2 + (1-2\Phi/c^2) d\mathbf{x}^2$  has  $G_{00} = 2\nabla^2 \Phi/c^2 = \kappa T_{00} = 8\pi G\rho/c^2$ , and the curvature integrated over a slice is  $\int G_{00} d^3x = \kappa \int T_{00} d^3x = \kappa E_0 = 2\pi \cdot 2R_s$ . [F06a, F06b]*

**Proposition 7** (The closure tension). *A steady closed strand carries a constant energy  $e_\ell$  per unit length: its energy flux  $e_\ell c$  is the same at every point. Let it run at the strand rate along a curve of curvature  $k$ . Its momentum flux  $(e_\ell/c) c = e_\ell$  (Q4) turns through  $k$  per unit length, which takes an inward force  $e_\ell k$  per unit length, and a tension  $\mathcal{T}$  supplies  $\mathcal{T}k$ . Hence*

$$\mathcal{T} = e_\ell \quad \text{at every point, for every shape of the strand,} \quad (16)$$

*and the strand's stress and the closure's cancel when integrated, as (Q3) requires. With  $m_\ell = e_\ell/c^2$  the inertia per unit length,*

$$\frac{\mathcal{T}}{m_\ell} = c^2. \quad (17)$$

*For the ring of (Q4),  $\mathcal{T} = E_s/(2\pi R)$ . Over a strand of length  $L$ ,  $E_0 = \mathcal{T}L$  and  $m = m_\ell L$ , the closed pattern's mass, closure included (Q3):  $E_0 = c^2 m$  is the tension over the inertia per unit length, applied to the whole length. Since  $\mathcal{T} < F_{\max}$  (Q2), every closed strand is longer than its Schwarzschild diameter,  $L = E_0/\mathcal{T} > E_0/F_{\max} = 2R_s$ . [F07a-d]*

The closure's stress holds the circulation, and  $c^2$  is the closure's tension over its strand's inertia per unit length, as a string's wave speed squared is its tension over its inertia per unit length.  $F_{\max}$  enters the closure only as its bound. Proposition 1 is (16) read at the ceiling: in  $E_0 = F_{\max} \cdot 2R_s$ ,  $2R_s$  is the length of strand that would carry  $E_0$  at the tension  $F_{\max}$ , which no strand reaches.

*Remark* (The two responses as a string). The two-response equations of *What  $c$  Is* (Prop. 1) have the form of a string's. In one dimension, with the vector grade  $\mathbf{E}_y$  as the velocity  $V$  and the twist  $-\mathbf{B}_z$  as the strain  $S$ ,  $\partial_t S = \partial_x V$  is Faraday's law and  $\varepsilon_0 \partial_t V = (1/\mu_0) \partial_x S$  is Ampère's: the inertia is  $\varepsilon_0$ , the stiffness (the coefficient of the strain) is  $1/\mu_0$ , and the wave speed squared is stiffness over inertia,  $1/(\varepsilon_0 \mu_0) = c^2$ . With the twist as the velocity,  $V = \mathbf{B}_z/\mu_0$  and  $S = -\varepsilon_0 \mathbf{E}_y$ , the inertia is  $\mu_0$  and the stiffness  $1/\varepsilon_0$ , and the ratio stays. [F08a, F08b] The two responses enter the chain only through their product,  $\varepsilon_0 \mu_0 = 1/c^2$ :  $1/(\varepsilon_0 \mu_0)$  and  $\mathcal{T}/m_\ell$  are each a stiffness over an inertia,  $E_0/m$  is the same ratio taken over a whole closed strand (Proposition 7), and  $(d/t)^2$  is the rate it sets.

## 6 The floor: where the two pairings meet

The quantum pairs a pattern's rest energy with a length the other way round. A pattern of rest energy  $E_0$  keeps the period  $T_q = h/E_0$ , and its strand runs  $\ell_q = cT_q$  in it (Q7); per radian of kept phase it runs the reduced Compton length

$$\bar{\lambda}_C = \frac{\ell_q}{2\pi} = \frac{\hbar c}{E_0} = \frac{\hbar}{mc}. \quad (18)$$

$\bar{\lambda}_C$  is a run of the strand, never the support  $R_{\text{box}}$  (I-5). The quantum pairing is  $E_0 = \hbar c/\bar{\lambda}_C$ : the rest energy grows as the length shrinks, where in the ceiling pairing  $E_0 = F_{\max} \cdot 2R_s$  it grows with the length.

**Proposition 8** (The two pairings multiply to the floor). *For every pattern or body, with  $E_0 \equiv \mathcal{M}c^2$ ,*

$$2R_s \cdot \bar{\lambda}_C = \frac{\hbar c}{F_{\max}} = d_{\min}^2, \quad \frac{2R_s}{c} \cdot \frac{\bar{\lambda}_C}{c} = t_{\min}^2. \quad (19)$$

*The floor length is the geometric mean of the gravitational diameter and the quantum length, and exactly one of the two lies above it unless both equal it:  $2R_s/d_{\min} = E_0/E_{\text{floor}}$  and  $\bar{\lambda}_C/d_{\min} = E_{\text{floor}}/E_0$ , so  $\bar{\lambda}_C > d_{\min} > 2R_s$  for  $E_0 < E_{\text{floor}}$ , the order reverses above, and the two lines cross at  $E_0 = E_{\text{floor}}$ , length  $d_{\min}$ . The map  $\ell \mapsto d_{\min}^2/\ell$  carries each length onto the other and is its own inverse, with the single fixed point  $d_{\min}$ ; it acts on the two lengths of one pattern or body and is neither  $\mathfrak{J}$  nor  $\mathfrak{i}$  of 0.3a. [F09a–c, F10c]*

*Proof.*  $2R_s = E_0/F_{\max}$  (Proposition 1) and  $\bar{\lambda}_C = \hbar c/E_0$ ; their product is  $\hbar c/F_{\max}$ , which is  $d_{\min}^2$  by (Q7). With  $E_{\text{floor}} = F_{\max} d_{\min}$ ,  $2R_s/d_{\min} = E_0/E_{\text{floor}}$ , and the product gives  $\bar{\lambda}_C/d_{\min} = E_{\text{floor}}/E_0$ .  $\square$

**Proposition 9** (The quantum length is a one-action stroke). *The run  $\bar{\lambda}_C$  in the time  $\bar{\lambda}_C/c$  under the mean force  $F_q = E_0/\bar{\lambda}_C$  has action  $F_q \bar{\lambda}_C^2/c = \hbar$ , with force fraction*

$$b = \frac{F_q}{F_{\max}} = \frac{2R_s}{\bar{\lambda}_C} = \left( \frac{d_{\min}}{\bar{\lambda}_C} \right)^2 = \left( \frac{E_0}{E_{\text{floor}}} \right)^2, \quad \bar{\lambda}_C = \frac{d_{\min}}{\sqrt{b}}, \quad \frac{\bar{\lambda}_C}{c} = \frac{t_{\min}}{\sqrt{b}} : \quad (20)$$

*the one-action stroke of 0.1a. [F10a, F10b]*

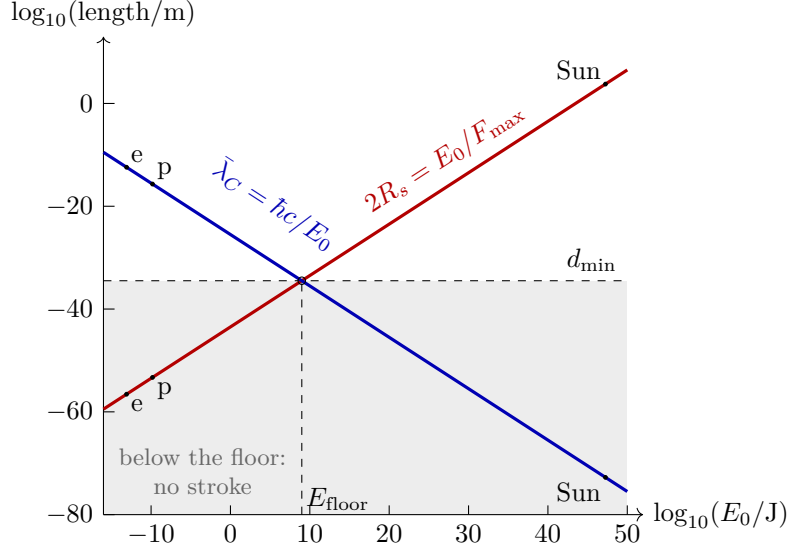


Figure 2: The two lengths of a pattern against its rest energy. The gravitational diameter  $2R_s = E_0/F_{\max}$  rises with slope +1, the quantum length  $\bar{\lambda}_C = \hbar c/E_0$  falls with slope  $-1$ , and their product is  $d_{\min}^2$  at every energy (Proposition 8). The lines cross at  $E_0 = E_{\text{floor}}$  and length  $d_{\min}$  (open circle: the floor, which no pattern occupies). Below  $E_{\text{floor}}$  a closed pattern's  $\bar{\lambda}_C$  is a stroke length and its  $2R_s$  the length of no stroke (electron e, proton p); above it, for a body of many patterns, the order reverses:  $2R_s$  lies above  $d_{\min}$  and  $\bar{\lambda}_C$  below, and neither is the run of one stroke (Sun). The shaded band lies below  $d_{\min}$ , the infimum of physical strokes.

*Proof.*  $F_q \bar{\lambda}_C^2/c = E_0 \bar{\lambda}_C/c = \hbar$  by (18).  $b = E_0/(F_{\max} \bar{\lambda}_C) = 2R_s/\bar{\lambda}_C$  by Proposition 1,  $= d_{\min}^2/\bar{\lambda}_C^2$  by (19), and  $= E_0^2/(\hbar c F_{\max}) = (E_0/E_{\text{floor}})^2$  because  $E_{\text{floor}}^2 = \hbar c F_{\max}$ .  $\square$

The ceiling pairing is the quantum pairing's force fraction:  $b$  is the gravitational diameter in units of the quantum length, and the square of the rest energy in units of the floor's.

**Proposition 10** (A closed pattern lies below the floor's energy). *By (Q8) a closed pattern's run per radian is a physical one-action stroke, and  $F_{\max}$  is never reached, so  $b < 1$ :*

$$\bar{\lambda}_C > d_{\min} > 2R_s \quad \text{and} \quad E_0 < E_{\text{floor}} = F_{\max} d_{\min}. \quad (21)$$

For a closed pattern  $\bar{\lambda}_C$  is a stroke length and  $2R_s$  the length of no stroke. A body of rest energy above  $E_{\text{floor}}$  is therefore no single closed pattern, and since there are only patterns (0.1b) it is many: a laboratory body, a star, a compact object. The construction of 0.3a repeats at every size, and above  $E_{\text{floor}}$  the count of patterns does not stay one; a nucleus lies below  $E_{\text{floor}}$  and is one pattern (0.1b). The floor, where the two lengths would coincide at  $b = 1$ , is approached by the least closed pattern, the one with the shortest  $\bar{\lambda}_C$  and the greatest rest energy, and occupied by none (0.1a). [F10c]

*Proof.*  $b < 1$  by (Q8) and (Q2). Then  $b = (E_0/E_{\text{floor}})^2$  (Proposition 9) gives  $E_0 < E_{\text{floor}}$ , and Proposition 8 gives the order of the lengths. A body with  $E_0 > E_{\text{floor}}$  contradicts (21), so it is no single closed pattern.  $\square$

**Proposition 11** (The closure tension at the floor). *Let the  $n$  strands of a braid ( $n \geq 2$ , I-5) each close once per kept period. Each strand has length  $\ell_q = 2\pi \bar{\lambda}_C$  and carries  $E_0/n$ , so by Proposition 7*

it carries the tension  $\mathcal{T}_{\text{br}}/n$ , and the braid's closure tension summed over its strands is

$$\mathcal{T}_{\text{br}} = \frac{E_0}{\ell_q} = \frac{F_q}{2\pi} = \frac{F_{\text{max}}}{2\pi} \left( \frac{d_{\text{min}}}{\bar{\lambda}_C} \right)^2, \quad (22)$$

the same for every  $n$ . As the pattern approaches the floor,

$$\mathcal{T}_{\text{br}} \rightarrow \frac{F_{\text{max}}}{2\pi} = \frac{1}{\kappa} = 4.8155 \times 10^{42} \text{ N} : \quad (23)$$

the modulus of the field equations (15) is the floor limit of a braid's summed closure tension, and  $\kappa = 2\pi/F_{\text{max}}$  is its compliance. In the floor limit the compliance relation  $\kappa E_0 = 2\pi \cdot 2R_s$  of Proposition 6 tends to  $\kappa E_{\text{floor}} = 2\pi d_{\text{min}}$ . [F11a, F11b, F14d]

*Proof.*  $\ell_q = cT_q = hc/E_0 = 2\pi\bar{\lambda}_C$  by (Q7) and (18). Each strand carries  $e_\ell = (E_0/n)/\ell_q$ , so  $\mathcal{T} = e_\ell$  (Proposition 7), and the sum over the  $n$  strands is  $E_0/\ell_q$ ;  $E_0/\bar{\lambda}_C = F_q = bF_{\text{max}}$  by (20); and  $b \rightarrow 1$  at the floor (Proposition 10).  $\square$

## 7 One rate, one modulus, one quantum

Three constants carry the conversions of this paper:

$$\begin{aligned} c : \quad d &= c\Delta t && \text{the strand rate (0.1d),} \\ F_{\text{max}} : \quad E_0 &= F_{\text{max}} d_s, \quad mc = F_{\text{max}} t_s && \text{the modulus (0.2),} \\ \hbar : \quad E_0 T_q &= h, \quad E_{\text{floor}} t_{\text{min}} = \hbar && \text{the quantum (0.1a).} \end{aligned} \quad (24)$$

The rate converts time into length. The modulus converts energy into length and momentum into time, for every pattern and body. The quantum converts energy into time for every pattern,  $E_0 T_q = h$ , and at the floor,  $E_{\text{floor}} t_{\text{min}} = \hbar$ . Their combinations carry the rest:  $c^2 = \mathcal{T}/m_\ell = 1/(\varepsilon_0 \mu_0)$ , the rate squared, a stiffness over an inertia, and  $E/m$  is that ratio taken over a whole closed strand;  $4G/c^4 = 1/F_{\text{max}}$  and  $\kappa = 2\pi/F_{\text{max}}$  (I-4), the compliances; and the floor,  $d_{\text{min}} = \sqrt{\hbar c/F_{\text{max}}}$ ,  $t_{\text{min}} = d_{\text{min}}/c$  and  $E_{\text{floor}} = F_{\text{max}} d_{\text{min}} = \sqrt{\hbar c F_{\text{max}}}$ . [F09a, F12]  $G$  is not a fourth constant. The floor is fixed by all three: it is the length at which a pattern's two lengths would coincide, approached by the least closed pattern and occupied by none.

|               | $E_0$ (J)                | $2R_s$ (m)               | $t_s$ (s)                | $\bar{\lambda}_C$ (m)    | $b = 2R_s/\bar{\lambda}_C$ |
|---------------|--------------------------|--------------------------|--------------------------|--------------------------|----------------------------|
| electron      | $8.1871 \times 10^{-14}$ | $2.7059 \times 10^{-57}$ | $9.0259 \times 10^{-66}$ | $3.8616 \times 10^{-13}$ | $7.0072 \times 10^{-45}$   |
| proton        | $1.5033 \times 10^{-10}$ | $4.9685 \times 10^{-54}$ | $1.6573 \times 10^{-62}$ | $2.1031 \times 10^{-16}$ | $2.3625 \times 10^{-38}$   |
| floor (limit) | $9.7804 \times 10^8$     | $3.2325 \times 10^{-35}$ | $1.0782 \times 10^{-43}$ | $3.2325 \times 10^{-35}$ | 1                          |
| Sun           | $1.7871 \times 10^{47}$  | $5.9065 \times 10^3$     | $1.9702 \times 10^{-5}$  | $1.7691 \times 10^{-73}$ | —                          |

Table 1: The two lengths of two closed patterns and one body, and of the floor they bound, which no pattern occupies (CODATA 2022 [4]; the Sun from the nominal  $G\mathcal{M}_\odot = 1.3271244 \times 10^{20} \text{ m}^3 \text{ s}^{-2}$  [5]). In every row  $2R_s \cdot \bar{\lambda}_C = d_{\text{min}}^2$  to  $10^{-12}$ . The electron's and the proton's  $2R_s$  and the Sun's  $\bar{\lambda}_C$  lie below  $d_{\text{min}}$ ; the Sun is many patterns, its  $\bar{\lambda}_C = \hbar c/E_0$  is a run of no strand, and its  $b$  is no force fraction. The electron and the proton are the same  $n = 3$  braid, read from the free room and from the nuclear room (I-5); their confinement-position masses at helix count  $n = 3$  are CODATA inputs. [F13b, F14a–c]

## 8 Declined reading and convergence

The standard account reads  $G$  as the strength of a coupling, and holds quantum gravity to be an open problem that sets in at the Planck scale. FDT reads  $F_{\max}$  as the modulus of the omnium and  $G$  as  $c^4/4F_{\max}$ ; the geometry is carried by the one quantised carrier, and the cascade steps space and time with mass (0.1a, I-2). The floor is the infimum of physical strokes, where the lines  $2R_s = E_0/F_{\max}$  and  $\bar{\lambda}_C = \hbar c/E_0$  cross, and no length below it belongs to a stroke (0.1a).

**Convergence.** For the same sources and data FDT returns Newton’s law of gravitation on the pair domain, exactly in model (Proposition 5; I-1, I-4 L1);  $E = mc^2$  and  $E^2 = (pc)^2 + (mc^2)^2$  (Proposition 3); Einstein’s field equations with  $\kappa = 8\pi G/c^4$ , and their weak-field form at leading order (Proposition 6; I-4 L2); and the reduced Compton lengths  $\hbar/(mc)$  (18). It uses the CODATA 2022 values unchanged,  $c$  and  $\hbar$  exact and  $G$  measured (Table 1). No divergence is claimed: the paper supplies what  $F_{\max}$  is, not a changed observable.

## 9 What $F_{\max}$ is

$F_{\max}$  is the modulus of the omnium. Energy is length in the ratio  $F_{\max}$  and mass is time in the ratio  $F_{\max}/c$ : the rest energy of a pattern or body is  $F_{\max}$  times its Schwarzschild diameter, and  $mc$ , the time component of its four-momentum at rest, is  $F_{\max}$  times the time the strand rate takes to cover that diameter. In motion the pairing covers the whole triangle of a closed pattern:  $E$ ,  $pc$  and  $mc^2$  are  $F_{\max}$  times the length the strand runs, the length it advances and the length it circulates. The same constant is linear in the pair law and, as  $F_{\max}/2\pi$ , in the field equations, and it bounds the tension that holds every closed pattern;  $c^2$  is any closed strand’s tension over its inertia per unit length. The chain  $E/m = c^2$  is the pairing’s quotient, with  $F_{\max}$  cancelled. With the quantum,  $F_{\max}$  fixes the floor, where the lines  $2R_s = E_0/F_{\max}$  and  $\bar{\lambda}_C = \hbar c/E_0$  cross: below the floor’s energy a closed pattern’s quantum length is a stroke and its gravitational diameter is not; above that energy, in a body of many patterns, the order reverses,  $2R_s$  above  $d_{\min}$  and  $\bar{\lambda}_C$  below, and neither is the run of one stroke.

## 10 Status register

| result                                                                                        | rests on                | status  |
|-----------------------------------------------------------------------------------------------|-------------------------|---------|
| Ceiling pairing $E_0 = F_{\max}d_s$ , $mc = F_{\max}t_s$ (Prop. 1)                            | 0.2                     | derived |
| Ceiling units; the chain read through the pairing (Cor. 1, Prop. 2)                           | Prop. 1; 0.1d           | derived |
| Energy triangle read at the ceiling tension; four-momentum; open stroke (Prop. 3, Cors. 2–3)  | Prop. 1; 0.1d, 0.5; I-2 | derived |
| Displacement spinor, $\mathbf{P} = F_{\max}\mathbf{D}$ (Prop. 4)                              | Prop. 3; 0.1d           | derived |
| Pair force as the modulus times two shares (Prop. 5)                                          | I-1, I-4 (L1), I-6; 0.2 | derived |
| Field equations with modulus $F_{\max}/2\pi$ ; weak-field integral at leading order (Prop. 6) | I-3, I-4 (L2); 0.2      | derived |
| Closure tension $\mathcal{T} = e_\ell$ ; $c^2 = \mathcal{T}/m_\ell$ ; $L > 2R_s$ (Prop. 7)    | I-2, I-5; 0.1d, 0.2     | derived |
| The two responses as a string (Remark, §5)                                                    | 0.1d                    | derived |
| Floor product; one length above the floor (Prop. 8)                                           | 0.1a, 0.2; Prop. 1      | derived |
| Quantum length as a one-action stroke (Prop. 9)                                               | 0.1a; Prop. 1           | derived |

| result                                                                     | rests on                                                     | status                             |
|----------------------------------------------------------------------------|--------------------------------------------------------------|------------------------------------|
| A closed pattern lies below the floor's energy (Prop. 10)                  | (Q8); 0.1a, 0.1b, 0.2                                        | derived                            |
| Braid's summed closure tension tends to $1/\kappa$ at the floor (Prop. 11) | Props. 7, 10; strands closing once per kept period; I-4, I-5 | derived                            |
| The run per radian as the closed pattern's floor-bounded stroke (Q8)       | 0.1a, I-4, I-5                                               | to be derived (D-F1)               |
| Closures per kept period and winding of each strand of a braid             | I-5                                                          | to be derived ([1] D-01; core O-9) |
| $m_p/m_e$ , the one $n = 3$ braid read from two rooms (Table 1)            | I-5                                                          | held-out target (O-9)              |

| invariant | where it enters                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| I-1       | the pair force as the modulus times two shares, exact on the pair domain (Prop. 5)                                                                                                                                                                                                                                                                                                                                    |
| I-2       | one carrier: a stroke carries momentum $1/c$ per unit energy, the flux the closure turns (Prop. 7); the open stroke keeps no time (Cor. 3); the closure carries no other rate (Q4); the cascade steps space and time with mass (§8)                                                                                                                                                                                   |
| I-3       | the field equations with modulus $F_{\max}/2\pi$ (Prop. 6); conserved stress-energy for the inertia of a closed pattern (Q3)                                                                                                                                                                                                                                                                                          |
| I-4       | Newton = GR = FDT: $F_{\max}\alpha_1\alpha_2 = (2\pi/\kappa)\alpha_1\alpha_2 = G\mathcal{M}_1\mathcal{M}_2/r^2$ , one modulus in the pair law and in the field equations (Props. 5, 6), exact in model on the pair domain (L1), containment in the static weak field (L2); the phase a pattern carries is its circulation (Q8)                                                                                        |
| I-5       | matter is closed stroke, and the closure's stress holds the circulation (Prop. 7); the helix count $n \geq 2$ of a braid is its class, and the closures per kept period and the winding of its strands are the operator's (Prop. 11; [1] D-01; core O-9); $\bar{\lambda}_C$ is a run of the strand, never $R_{\text{box}}$ (§6); the electron and the proton are the same $n = 3$ braid read from two rooms (Table 1) |
| I-6       | the shares of the pair law lie in the open interval, so $F < F_{\max}$ (Prop. 5)                                                                                                                                                                                                                                                                                                                                      |
| I-7       | every energy enters $\mathcal{M}$ once: a closed pattern's $\mathcal{M}c^2$ is its rest energy $E_0$ , closure included (Q3), with Schwarzschild diameter $d_s = E_0/F_{\max}$ (Prop. 1)                                                                                                                                                                                                                              |

## A Receipt

The script `receipt_fmax.py`, in the folder of this paper, checks the displayed identities symbolically with SymPy and every displayed number against the printed five-figure string; its output is `receipt_output.txt`. Run `python3 receipt_fmax.py`. Result: **39/39 PASS**. Checks F07a and F10a confirm definitions; the others test claims.

| check  | content                                                                                                                                                                                                                                                      |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| F01a-b | $E_0 = F_{\max} \cdot 2R_s$ with both forms of 0.2; $mc = F_{\max}t_s$ ; $m/d_s = F_{\max}/c^2$ , $E_0/t_s = F_{\max}c$ , $m/t_s = F_{\max}/c$                                                                                                               |
| F02a-b | $E_0/m = c d_s/t_s = (d_s/t_s)^2$ ; $(E_0/F, mc/F)$ on $d = ct$ for any $F$ ; the squared pairing's factor $F_{\max}/d_s$ , a force per length; ceiling units $E_0 = d_s$ , $m = t_s$ , $G = 1/4$ , $\hbar = d_{\min}^2$                                     |
| F03a-c | legs (6) over $\Delta\tau = t_s$ ; $E = F_{\max}d$ , $pc = F_{\max}x$ , $mc^2 = F_{\max}c\Delta\tau$ ; $d = E/F_{\max}$ ; (8)                                                                                                                                |
| F03d   | boosting $(ct_s, 0)$ gives $(d, x)$ , and $F_{\max}/c$ times it is $(E/c, p)$                                                                                                                                                                                |
| F03e   | open stroke at fixed energy: $F_{\max}c\Delta\tau \rightarrow 0$ and $F_{\max}x - E \rightarrow 0$ as $\beta \rightarrow 1$ , with $F_{\max}d = E$                                                                                                           |
| F04a-b | Cl(2): $\Sigma^2 = -1$ , $\mathbf{D} = \Delta t \mathbf{w}$ , $\mathbf{P} = F_{\max} \mathbf{D} = pc + mc^2 \Sigma = (E/c) \mathbf{w}$ ; $\mathbf{D}\tilde{\mathbf{D}} = d^2$ , $\mathbf{P}\tilde{\mathbf{P}} = E^2$                                         |
| F05a-c | I-1, I-4: $F_{\max}\alpha_1\alpha_2 = (2\pi/\kappa)\alpha_1\alpha_2 = G\mathcal{M}_1\mathcal{M}_2/r^2 = E_{0,1}E_{0,2}/(4F_{\max}r^2)$ ; the bound $F \leq F_{\max}/4$ over the pair domain; $U = -F_{\max}\alpha_1\alpha_2 r$ , $\partial U/\partial r = F$ |

| check  | content                                                                                                                                                                                                                                                                                                                                                                                                      |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| F06a–b | $\kappa F_{\max} = 2\pi$ ; $T_{\mu\nu} = (F_{\max}/2\pi)G_{\mu\nu}$ ; $\kappa E_0/2\pi = 2R_s$ ; $G_{00} = 2\nabla^2\Phi/c^2$ computed from the weak-field metric, then integrated over a uniform sphere: $2\pi \cdot 2R_s$                                                                                                                                                                                  |
| F07a–d | closure: $\mathcal{T}k = (e_\ell/c)ck$ (definition); on an ellipse the net force and the integrated stress vanish only at $\mathcal{T} = e_\ell$ ; $\mathcal{T}/m_\ell = c^2$ ; $E_0 = \mathcal{T}L$ , $m = m_\ell L$ ; $L > 2R_s$ for $\mathcal{T} < F_{\max}$                                                                                                                                              |
| F08a   | the two responses as a string, for generic fields $\mathbf{E}_y(x, t)$ , $\mathbf{B}_z(x, t)$ and both assignments (inertia $\varepsilon_0$ , stiffness $1/\mu_0$ ; inertia $\mu_0$ , stiffness $1/\varepsilon_0$ ): the string pair is Faraday’s and Ampère’s law; $\mu_0\partial_t(\text{Ampère}) - \partial_x(\text{Faraday})$ is $\varepsilon_0\mu_0\partial_t^2\mathbf{E}_y - \partial_x^2\mathbf{E}_y$ |
| F08b   | plane wave, the amplitude of $\mathbf{B}_z$ and $\omega$ solved from the two laws: $\omega^2/k_x^2 = 1/(\varepsilon_0\mu_0)$                                                                                                                                                                                                                                                                                 |
| F09a–c | floor: $d_{\min} = 2\ell_P$ , $t_{\min} = 2t_P$ , $E_{\text{floor}} = E_P/2$ , $E_{\text{floor}}t_{\min} = \hbar$ ; $2R_s\bar{\lambda}_C = d_{\min}^2$ for every mass; $(2R_s/c)(\bar{\lambda}_C/c) = t_{\min}^2$ ; $\ell \mapsto d_{\min}^2/\ell$ an involution exchanging the two, fixed point $d_{\min}$                                                                                                  |
| F10a–c | one-action stroke $F_q\bar{\lambda}_C^2/c = \hbar$ (definition); $b = 2R_s/\bar{\lambda}_C = (d_{\min}/\bar{\lambda}_C)^2 = (E_0/E_{\text{floor}})^2$ ; $\bar{\lambda}_C = d_{\min}/\sqrt{b}$ ; $2R_s/d_{\min} = E_0/E_{\text{floor}}$ , $\bar{\lambda}_C/d_{\min} = E_{\text{floor}}/E_0$ ; all equal at $E_{\text{floor}}$                                                                                 |
| F11a–b | braid of $n$ strands: $\ell_q = 2\pi\bar{\lambda}_C$ ; $\mathcal{T}_{\text{br}}/n$ each; $\mathcal{T}_{\text{br}} = E_0/\ell_q = F_q/2\pi = (F_{\max}/2\pi)(d_{\min}/\bar{\lambda}_C)^2$ , independent of $n$ ; $\mathcal{T}_{\text{br}} \rightarrow F_{\max}/2\pi = 1/\kappa$ ; $\kappa E_{\text{floor}} = 2\pi d_{\min}$                                                                                   |
| F12    | $E_{\text{floor}} = \sqrt{\hbar c F_{\max}}$ , $G = c^4/4F_{\max}$ , $\kappa = 2\pi/F_{\max}$                                                                                                                                                                                                                                                                                                                |
| F13a–c | $F_{\max}$ , $F_{\max}/c$ , $F_{\max}c$ , $F_{\max}/c^2$ , $1/\kappa$ ; $d_{\min}$ , $t_{\min}$ , $E_{\text{floor}}$ ; one joule and one kilogram at the ceiling                                                                                                                                                                                                                                             |
| F14a–d | Table 1, every printed entry; $2R_s\bar{\lambda}_C = d_{\min}^2$ in every row; the floor limit $1/\kappa$                                                                                                                                                                                                                                                                                                    |
| F15    | Figure 2: line endpoints, the crossing and the six points, to 0.01 in $\log_{10}$                                                                                                                                                                                                                                                                                                                            |

## References

- [1] M. Alfaro, *What c Is: A geometric derivation of the space-time and matter-energy conversion in Fundamental Density Theory* (18 October 2026); derivation of record for core v6.1.
- [2] Fundamental Density Theory, *Core FDT Invariants*, v6.1 (author lock 2026-10-18).
- [3] M. von Laue, “Zur Dynamik der Relativitätstheorie,” *Annalen der Physik* **35** (1911) 524–542.
- [4] P. J. Mohr, D. B. Newell, B. N. Taylor and E. Tiesinga, “CODATA recommended values of the fundamental physical constants: 2022,” arXiv:2409.03787.
- [5] E. E. Mamajek *et al.*, “IAU 2015 Resolution B3 on recommended nominal conversion constants for selected solar and planetary properties,” arXiv:1510.07674.