

Clocks scales and physical identification

PDT Foundations R08

Prepared for Graham Fincham and Daniel Hilton

Review draft 1.0 • 24 September 2026

Purpose and dependencies

A sequence can have an order without a duration, and a relational carrier can have a dimension without a measured length. This paper states the physical identifications needed after R03 and R07. It also gives the exact calibration algebra used throughout the suite. Calibration supplies units. An independently selected dimensionless relation is still needed for a numerical prediction.

Order is not a clock

For any strictly increasing function f , replacing an episode parameter s by $f(s)$ preserves which event comes first. It generally changes durations and rates. For instance s and s^2 give the same ordering on positive values but different elapsed intervals. Hence A5's record order and A6's first singleton criterion do not determine a physical clock.

The premise **T1** must specify a repeatable clock observable and a map from model development to its readings. Where a common spacetime is invoked, **T2** must identify proper time and causal structure consistently for all relevant sectors. A rate such as Γ in R05 is a laboratory rate only after T1. A gravitational time dilation claim requires T2 as well.

For a differentiable reparameterisation $t = f(s)$ with $f'(s) > 0$, an equation $d\psi/ds = A(s)\psi$ becomes $d\psi/dt = A(s)\psi/f'(s)$. Thus the ordering alone cannot select an energy or a universal event rate. A change that makes a previously constant generator time dependent is not innocuous when a model claims an autonomous physical law.

Mechanical calibration

Adopt **K1**, a fixed mechanical calibration convention. With a mass anchor m_e and declared conversions c and $\hbar$, set

$$M_0 = m_e, L_0 = \frac{\hbar}{m_e c}, T_0 = \frac{\hbar}{m_e c^2}.$$

Here the electron mass is an empirical anchor. Its appearance does not mean PDT has predicted the electron mass. Given the causal and action conversions, it supplies the one mechanical ruler used in the earlier scale suite. The choice of SI or another unit system is a reporting convention.

Proposition R08.1 Dimensional exponent formula. If $[Q] = M^a L^b T^d$, then a dimensionally admissible expression in this basis has the form

$$Q = q_Q m_e^{a-b-d} \hbar^{b+d} c^{-b-2d}.$$

Proof. Write exponents x, y, z on $m_e, \hbar, c$. Matching dimensions gives $x + y = a$, $2y + z = b$ and $-y - z = d$. Solving yields $x = a - b - d$, $y = b + d$ and $z = -b - 2d$. The coefficient q_Q remains arbitrary under this dimensional calculation. ■

Quantity	Calibrated unit scale	Still to be selected
Length	$\hbar / (m_e c)$	Dimensionless length
Time	$\hbar / (m_e c^2)$	Dimensionless duration
Energy	$m_e c^2$	Dimensionless energy
Action	$\hbar$	Dimensionless action
Newton constant	$\hbar c / m_e^2$	$G m_e^2 / (\hbar c)$

Electromagnetic unit conventions require their own charge normalisation. No change of units can determine the dimensionless fine structure constant. The same is true of mass ratios and mixing angles.

Calibration rank and physical freedom

In general, a dimension matrix maps exponents of chosen anchors to physical dimensions. Full rank means that the relevant unit conversions can be solved. It says nothing about the values of dimensionless observables, which lie outside that dimensional information.

For example two models can use exactly the same $m_e, c, \hbar$ and different positive values of $q_G = G m_e^2 / (\hbar c)$. Both satisfy Proposition R08.1. A further physical relation must select one if PDT claims to predict gravity's strength. Replacing the relation by the measured value is a calibration or fit and should be reported as such.

The distinction also affects action normalisation. If a sector has mass $m_j = \mu K I_j$ and the electron fixes the common scale, then

$$\frac{m_j}{m_e} = \frac{I_j}{I_e}.$$

The division is exact. It does not calculate either invariant or their ratio. R09 gives a counterexample to the claim that stable sectors plus this normalisation select a spectrum.

Geometry is another identification

The positive metric of R07 is a dimensionless internal inner product. Multiplying it by L_0^2 supplies length units only after vectors in that carrier are identified with physical displacements. Multiplying by a unit cannot establish that identification.

Likewise a spatial inner product and an ordered parameter can be used in a Galilean description or in a Lorentzian one. Neither A5 nor R07 selects between them. A spacetime bridge has to state signature, causal cone, the relation between clock readings and the metric, and universality across matter and measuring devices. R10 examines a conditional Lorentzian completion rather than declaring that these choices have already emerged.

The unit convention in R10 and R11 is $c = \hbar = 1$. This is only shorthand after K1. It does not remove physical dimensionless parameters or explain their values.

A transfer test

A useful prediction freezes a microscopic law and its calibration in one setting, then computes an observable in another using independently measured preparation and apparatus inputs. Refitting a free coefficient to each target does not test transfer.

For a proposed constant, the review record should specify the formula, the allowed empirical anchors, the selected solution branch, the numerical evaluation error and any systematic uncertainty. It should state which datum was withheld from selection. This suite contains no new independently derived numerical constant, so none is presented as a committed PDT prediction.

Status and sources

The exponent formula and the freedom left by calibration are proved. T1, T2 and K1 are physical or reporting inputs. A universal clock, a common physical geometry and numerical dimensionless constants remain to be selected by an identified model.

[S06] *PDT Universal Scale Calibration Suite*, revised version 1.1, 8 September 2026. Internal source file PDT_Universal_Scale_Calibration_Suite_v1_1_Revised.pdf.

[S01] *PDT Foundations and Physical Closure*, 12 September 2026, Sections 14 and 15. The exponent formula above is the corrected version retained in these sources.