An Absolute-Space Derivation of Relativistic Time Dilation and the Relativistic Origin of Magnetism

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Abstract

This paper presents a first-principles derivation of special-relativistic time dilation, weak-field gravitational time dilation, and the magnetic force between moving charges, starting from a small set of classical postulates: an absolute three-dimensional space with a fixed, observer-independent distance structure; time treated not as an independent dimension but as a monotonic ordering derived from motion; and the assumption that every physical system possesses a perpetual internal process (an internal "signal") propagating at a fixed maximum rate. Combining this foundation with elementary geometry, Newtonian orbital mechanics, and the equivalence principle reproduces the standard Lorentz factor, the measured GPS relativistic clock corrections (approximately +45 microseconds per day from gravitational potential and -7 microseconds per day from orbital velocity), and the standard magnetic field of a current-carrying wire, all to good numerical agreement with established values. The paper is explicit about what this demonstrates and what it does not: every quantitative result obtained here is mathematically identical to the corresponding result in standard special and general relativity and classical electromagnetism. This work is presented as an alternative, internally consistent derivation of known physics from an absolute-space foundation, not as a new predictive theory. A concluding section identifies the specific gap - the absence of any point of numerical divergence from standard theory - that would need to be closed for this foundation to constitute a genuinely new, testable physical claim.

1. Foundational Postulates

The framework rests on four postulates, developed and pressure-tested against known physics over the course of this project:

Postulate 1 (Absolute Space). There exists a single, universal three-dimensional spatial structure with a fixed, observer-independent distance between any two points. No coordinate grid or reference frame is required for this structure to exist; the distance between two points is a real fact, not a convention. This spatial structure is unbounded, extending infinitely in every direction, with no edge or outer limit.

Postulate 2 (Time as Ordering, Not Dimension). Time is not a dimension on equal footing with space. It is a monotonic, forward-only ordering of events, derived from the accumulation of motion rather than existing as an independent substance.

Postulate 3 (Eternal Motion). Motion is not caused; it is an eternal, foundational feature of the system. No physical account is required, or offered, for why motion exists in the first place.

Postulate 4 (Perpetual Internal Motion at a Fixed Rate). No physical system is ever truly at rest. Every particle possesses a perpetual internal process, modeled here as a signal propagating between two internal points, that travels at a fixed maximum rate, denoted c. Bulk motion of the system through absolute space is added on top of this internal motion, not in place of it.

Postulates 1 through 3 are philosophical commitments about the nature of space, time, and motion. Postulate 4 is the load-bearing physical assumption from which the quantitative results below are derived. The unbounded extent specified in Postulate 1 is not a passive addition: it is the boundary condition required for the flow-speed derivation in the companion Empirical Verification Ledger, where motion at infinite distance from any mass is taken to have no net inward component.

2. Special-Relativistic Time Dilation from Internal Motion

Consider a particle whose internal signal bounces between two fixed points separated by distance L, at fixed speed c.

At rest, one round trip takes:

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T0 = 2L / c
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When the particle moves at bulk velocity v through absolute space, the internal signal must trace a diagonal path to keep pace with the moving particle, since the two internal points have shifted sideways during the signal's transit. Applying the Pythagorean theorem to this diagonal path, with the signal still constrained to travel at fixed speed c, gives:

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T = 2L / sqrt(c^2 - v^2) = T0 / sqrt(1 - v^2/c^2)
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This is the standard Lorentz factor, gamma = 1/sqrt(1 - v^2/c^2), obtained directly from Postulate 4 and elementary geometry. No target value was assumed in advance; the factor is a consequence of the fixed propagation rate of the internal signal combined with the geometry of bulk motion.

This derivation is mathematically identical to the standard "light clock" thought experiment used to introduce special relativity, and is closely related to the historical Lorentzian interpretation of relativity developed by Lorentz and Poincare, in which a real, physical absolute rest frame underlies relativistic effects. The Lorentzian and Einsteinian formulations are known to be empirically indistinguishable; this paper's derivation falls within the Lorentzian tradition.

3. Gravitational Time Dilation via the Equivalence Principle

Gravitational time dilation is obtained by combining the result of Section 2 with the equivalence principle: being at rest in a gravitational field of local strength g is physically indistinguishable from undergoing uniform acceleration a = g through absolute space, in the absence of any mass.

Consider a light pulse emitted from the floor of a uniformly accelerating enclosure toward its ceiling, a height h above. The light's travel time is approximately t = h/c, during which the ceiling accumulates velocity v = at = ah/c in the direction of the light's motion. The classical Doppler shift for this small velocity gives:

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Delta-f/f ~= -v/c = -ah/c^2
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Applying the equivalence principle (a -> g) and noting that gh is the gravitational potential difference Delta-U over height h in a uniform field:

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Delta-f/f ~= -Delta-U/c^2
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Comparing clock rates directly rather than light in transit, a clock at higher gravitational potential runs faster than one at lower potential by:

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Delta-f/f = +Delta-U/c^2
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Generalizing from a uniform field to the true 1/r potential of a spherical mass, Delta-U = GM(1/r1 - 1/r2), this becomes directly applicable to a satellite in orbit around a planet.

4. Numerical Verification Against GPS

The two results above were checked against the operational relativistic correction applied to GPS satellite clocks, using Earth's GM = 3.986 x 10^14 m^3/s^2, Earth radius 6.371 x 10^6 m, and GPS orbital radius 2.6571 x 10^7 m (orbital altitude ~= 20,200 km).

Orbital velocity, from Newton's circular-orbit condition GM/r^2 = v^2/r, gives v^2 = GM/r ~= 1.500 x 10^7 m^2/s^2, or v ~= 3.87 km/s, matching the known orbital speed of GPS satellites.

Velocity time dilation (Section 2): Delta-f/f = -v^2/(2c^2) ~= -8.33 x 10^-11, equivalent to approximately -7.2 microseconds per day.

Gravitational time dilation (Section 3): using Delta-U = GM(1/r_earth - 1/r_sat) ~= 4.759 x 10^7 m^2/s^2, Delta-f/f = Delta-U/c^2 ~= 5.29 x 10^-10, equivalent to approximately +45.7 microseconds per day.

Net predicted offset: approximately +38.5 microseconds per day, in close agreement with the well-established, operationally applied GPS relativistic correction of +38 microseconds per day (Ashby & Weiss; Fliegel & DiEsposti).

5. Magnetism as a Relativistic Effect of Electric Charge

The framework was extended to electromagnetism by applying the same length-contraction consequence of Section 2 to a current-carrying wire, following the approach originally presented by Purcell (Electricity and Magnetism).

A current-carrying wire contains a lattice of positive charges at rest and a population of negative charges (electrons) drifting at velocity u; the wire is electrically neutral in its own rest frame. Viewed from the rest frame of an external test charge moving at velocity v parallel to the wire, the two charge populations are moving at different velocities relative to the test charge, and therefore undergo different degrees of length contraction. This breaks the exact neutrality observed in the wire's own frame, producing a net charge density and therefore a real electric field in the test charge's frame, which exerts an ordinary electric force on the test charge.

Transforming this force back into the wire's rest frame reproduces exactly the standard magnetic force law, F = qv x B, with B given by the standard formula for the field around a current-carrying wire, B = mu0*I/(2*pi*r).

A numerical check using a 1 A current in a copper wire (free electron density ~= 8.5 x 10^28 m^-3, cross-sectional area 1 mm^2) gives an electron drift velocity of only u ~= 7.35 x 10^-5 m/s, and a corresponding fractional charge imbalance between the two populations of order 3 x 10^-26, an extraordinarily small effect. That this vanishingly small relativistic imbalance, combined with the large prefactor of Coulomb's constant, reproduces the full, everyday strength of magnetic forces is the substantive content of the result: magnetism requires no independent fundamental field in this framework. It is fully accounted for as a relativistic consequence of electric charge and motion, using the same mechanism (Section 2) already responsible for special-relativistic time dilation.

6. Interpretation Note: Flat Space and Curvature-Equivalent Results

Section 3 and the companion Ledger's treatment of Mercury's perihelion precession combine this foundation's flat, three-dimensional absolute space (Postulate 1) with an established mathematical framework (a metric and the geodesic principle) to obtain results that are numerically identical to those of curved-spacetime General Relativity. This equivalence warrants explicit interpretation, so that it is not mistaken for either a contradiction or a concealment.

The three-dimensional background posited in Postulate 1 is not altered, warped, or stretched by this framework at any point. What is combined, for the purpose of calculation, is this unaltered spatial structure together with a separately-treated time whose local rate varies with motion and gravitational potential (Sections 2 and 3). The mathematical tool used to combine these two for computation reproduces the same predictions as a genuinely curved four-dimensional spacetime, without requiring that space and time be treated as forming a single curved manifold in the sense standard General Relativity does. This is analogous to, and consistent with, the Lorentzian interpretation already adopted in Section 2: the same mathematics, understood through a different account of what is physically real.

Update (companion Ledger and standalone Light-Bending note, revised July 28, 2026): the spatial component of this equivalence, previously treated above as an adopted mathematical tool, has since been independently derived rather than adopted. Applying ordinary special-relativistic length contraction -- the same physical reasoning underlying Einstein's rotating-disk argument, here applied to the foundation's own derived flow speed, v_flow(r) = sqrt(2GM/r), rather than to a spinning disk's tangential motion -- gives a radial stretching factor of 1/(1 - v_flow^2/c^2), shown to be algebraically identical, term for term, to the spatial component of the Schwarzschild metric. This derived spatial term, combined with the gravitational time dilation already established in Section 3, has been independently verified against five separate, real physical measurements: the perihelion precession of Mercury, Venus, and Earth; the gravitational deflection of starlight grazing the sun (matching the real, historically confirmed value of 1.75 arcseconds); and the Shapiro time delay of a radar signal passing near the sun (matching the real, historically confirmed value of approximately 250 microseconds for an Earth-Mars round trip). In each case, the same mechanism was applied without modification or re-tuning between cases.

This result strengthens, but does not settle, the interpretive position taken above. It establishes that the numerical equivalence between this foundation's flat-space treatment and curved-spacetime General Relativity extends further, and rests on a more directly derived mechanism, than previously demonstrated in this paper. It does not resolve the underlying philosophical question of whether flat space combined with a variable time rate and this derived spatial term is physically distinguishable from genuine four-dimensional curvature, or is merely a difference in description; that question remains open, and this paper continues to take no position on it beyond noting that the equivalence itself is now more precisely characterized than before.

7. Status and Open Questions

The results in Sections 2 through 5 are internally consistent, derived without free parameters chosen after the fact, and numerically verified against known values. The following points are stated plainly so that the scope of this work is not overstated.

7.1 - Every quantitative result in this paper, and in the companion documents referenced below, is mathematically identical to the corresponding result in standard special relativity, general relativity (weak-field and, per Section 6's update, the spatial-curvature regime as well), and classical electromagnetism. No experiment currently known could distinguish this framework's predictions from those of standard theory, because the same underlying invariance (a fixed maximum signal speed, and the equivalence principle) was used in both derivations.

7.2 - This work is best understood as belonging to the Lorentzian tradition of interpreting relativity: it proposes a physically real absolute space and a mechanical account of why moving and gravitationally displaced clocks run at different rates, as an alternative to treating spacetime curvature as fundamental. It does not currently offer, and does not claim to offer, a new prediction that would empirically favor it over the standard formulation.

7.3 - Several candidate mechanisms explored during the development of this framework, including proposals that gravitational and magnetic field strength are generated directly by a body's rotation rate or core temperature, were tested against real planetary data (comparative surface gravity and magnetic field strength of Earth, Venus, and Jupiter) and did not hold up. These mechanisms have been abandoned and are not part of the framework presented here.

7.4 - The central open problem for this framework remains identifying a specific physical regime in which its postulates force a numerical prediction different from standard relativity and electromagnetism. The work reported in Section 6's update extends the range of phenomena over which this framework's predictions are shown to agree exactly with standard theory (now including light bending and the Shapiro time delay, in addition to time dilation and orbital precession), using a more directly derived mechanism than previously available. This constitutes progress in precisely characterizing the equivalence, but it is progress in the opposite direction from resolving 7.4: no point of numerical divergence from standard theory has been identified, and the newly derived spatial term, having been checked against real data across three planets and two independent phenomena without modification, is not expected to be the source of one. Absent such a divergence, this framework should continue to be regarded as an alternative derivation and interpretation of established physics, not as a competing physical theory.

7.5 - Four companion documents track ongoing independent tests of this foundation. The Empirical Verification Ledger tracks tests against additional real-world phenomena beyond GPS, including cosmic-ray muon decay, the Ives-Stilwell and Pound-Rebka experiments, and a resolved treatment of Mercury's, Venus's, and Earth's perihelion precession. A standalone note, Light Bending and the Shapiro Time Delay, applies the same derived mechanism to two further phenomena. The Gravitational Radiation Investigation records the attempt at the one dynamical test known to have historically separated genuine alternatives to general relativity from those that ultimately failed: the Hulse-Taylor binary pulsar's orbital decay rate from gravitational-wave emission. That investigation resolved the required tensor shape of the radiation as a citable mathematical necessity of Postulate 4, proved this shape requirement holds independent of which physical force is involved, and identified the case for a fifth postulate -- a fixed floor on physical action, supplied by hbar and adopted with the same transparent status as G -- as necessary to reach the radiation's magnitude; that magnitude itself remains an open, actively pursued question. A further standalone note, Neutron Star Radius from the Fifth Postulate, tests this same fifth postulate against a separate, independently measured quantity (a real neutron star's physical size) and finds it correct to within observational uncertainty. All four documents should be consulted for the current state of testing beyond what is presented here.

References

Ashby, N. and Weiss, M., Global Positioning System Receivers and Relativity, NIST.

Fliegel, H. F. and DiEsposti, R. S., GPS and Relativity: An Engineering Overview.

Purcell, E. M., Electricity and Magnetism (Berkeley Physics Course, Vol. 2).

Bell, J. S., How to Teach Special Relativity, Progress in Scientific Culture, 1976.

Hamilton, A. J. S., and Lisle, J. P. (2008). The River Model of Black Holes. American Journal of Physics, 76(6), 519-532.