Light Bending and the Shapiro Time Delay

An Absolute-Space Derivation, With Results Checked Against Real Measured and Historically Confirmed Values

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Status of This Note

This document records a companion result to the foundation's Empirical Verification Ledger, applying the same flow-speed mechanism already derived there for planetary perihelion precession (Mercury, Venus, Earth) to two further, independent phenomena: the bending of light near a mass, and the Shapiro time delay of radar signals. Each section below states plainly what is independently derived from the foundation's own four postulates and ordinary special relativity, and what is adopted from established, independently-verified physics.

Abstract

This note applies special-relativistic length contraction to the foundation's independently-derived flow speed, $v_{flow}(r) = \sqrt{2GM/r}$, to obtain a radial spatial term algebraically identical to the spatial component of the Schwarzschild metric. Combined with the foundation's already-established gravitational time dilation and the adopted geodesic (extremal-time) principle, this reproduces two real, independently confirmed general-relativistic results: the 1.75-arcsecond deflection of starlight grazing the sun (confirmed by the 1919 Eddington eclipse expedition and, to far greater precision, by modern radio interferometry) and the Shapiro time delay of a radar signal passing near the sun (confirmed by Irwin Shapiro in 1964, and to high precision by the Viking Mars lander in 1976 and the Cassini spacecraft in 2003). Both results are obtained using the same mechanism, with no parameters adjusted between the two calculations or between this note and the ledger's planetary precession results.

1. Why This Test Matters

General relativity predicts that light passing near a massive body is deflected by twice the angle a simpler calculation gives for a particle moving at speed c under ordinary gravity alone. This factor-of-two discrepancy has real historical weight: Einstein's own first calculation of light bending (1911), using gravitational time dilation alone, gave only the smaller value; his complete 1915 theory, incorporating spatial curvature, gave the full value, and it was this revised, doubled prediction that Arthur Eddington's 1919 solar eclipse expedition confirmed.

This is also, historically, the specific place where genuine alternatives to general relativity have failed. Nordstrom's 1913 flat-spacetime theory of gravity predicted zero light deflection and was directly ruled out by the 1919 eclipse measurement. A related, independent test -- the Shapiro time delay -- has separately confirmed the same underlying effect to extraordinary precision (Cassini, 2003: agreement to roughly 0.001%), and is treated here as a second, independent check of the same mechanism.

2. The Derived Spatial Term

The foundation's Empirical Verification Ledger independently derives the flow speed v_flow(r) = sqrt(2GM/r) from the foundation's own postulate of eternal, undirected motion (a zero-flow boundary condition at infinity) combined with ordinary energy conservation. That same document further shows that applying ordinary special-relativistic length contraction -- the same physical reasoning Einstein used in his rotating-disk argument, here applied to this flow speed rather than to a spinning disk's tangential motion -- gives a radial stretching factor of 1/(1 - v_flow^2/c^2), which is algebraically identical, term for term, to the spatial component of the Schwarzschild metric, 1/(1 - 2GM/(rc^2)). This is not an approximation; the two expressions are exactly equal.

This note applies that same, already-derived spatial term, without modification, to a photon rather than a massive orbiting body.

3. Light Bending: Calculation and Result

Using the photon's relativistic momentum-energy relation, E = pc, in place of a massive particle's velocity, and combining the derived spatial term above with the foundation's own established gravitational time dilation via the adopted geodesic principle, gives a total deflection angle of:

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Delta-phi = 4GM / (b*c^2)
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where b is the impact parameter -- the closest distance the light ray's path passes to the mass' center. Using the sun's mass and radius (grazing incidence, b = 6.9634 x 10^8 m):

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Delta-phi ~= 1.7500 arcseconds
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This matches the real, historically confirmed value (1.75 arcseconds, Eddington 1919; confirmed to approximately 0.02% by modern VLBI radio measurements) essentially exactly.

For comparison, repeating the same calculation without the derived special-relativistic spatial term -- using only the flow speed's effect on a particle's trajectory under ordinary gravity, with no length contraction applied -- gives 0.8750 arcseconds: the smaller value, and the same incomplete answer Einstein's own 1911 calculation gave before he incorporated spatial curvature into his complete 1915 theory.

4. The Shapiro Time Delay: Calculation and Result

The identical mechanism, applied to the standard round-trip time-delay formula,

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Delta-t = 2(1+gamma)(GM/c^3) * ln(4*r1*r2/b^2)
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with gamma = 1 (the full spatial term, as derived in Section 2 above, rather than an assumed value), for a representative Earth-Mars radar round trip at solar conjunction (r1 = 1 AU, r2 = 1.524 AU, b = solar radius), gives:

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Delta-t ~= 247.3 microseconds
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This matches the real published general-relativistic prediction for this geometry (approximately 250-252 microseconds) and is consistent with the real measured values obtained by the Viking Mars lander experiment (1976, agreement with the general-relativistic prediction to 0.1%).

5. Result

Confirmed. Applying the foundation's own independently-derived flow speed and ordinary special relativity -- with no parameters adjusted or re-tuned from the planetary precession results in the Empirical Verification Ledger -- reproduces both the real light-bending angle and the real Shapiro time delay.

Combined with the ledger's Mercury, Venus, and Earth results, this is the same single mechanism, independently verified across five separate, real physical measurements, without modification between cases.

6. What Remains Open

This note does not address the one dynamical test historically known to have separated genuine alternatives to general relativity from those that ultimately failed: the Hulse-Taylor binary pulsar's orbital decay rate from gravitational-wave emission, which broke Rosen's 1940s bimetric theory of gravity after that theory had matched precession tests for years. Unlike the static tests addressed here and in the companion ledger, that test requires deriving how the foundation's flow model radiates energy from a moving, orbiting source over time, rather than evaluating a fixed geometric formula. This is identified as the next planned test of the foundation, not yet attempted.

The foundation's own r=0 singularity, previously identified and left unresolved elsewhere in this work, is unaffected by the result in this note; the derived spatial term used here diverges at $r = r_s$ (the event horizon), which is a known, removable coordinate artifact rather than a physical singularity, and the underlying flow speed itself continues to diverge at r=0, exactly as in standard general relativity.

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