

Addendum 384: The Equivalence Principle

Gravity is geometry, so free-fall is the inertial coast —
inertial mass = gravitational mass, structurally

(Assembles Addendum 383 with Papers 04, 17 and Addendum 372)

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Abstract

Addendum 383 gave inertia — the conserved-invariant coast. The corpus separately has gravity as the fold/self-lensing geometry, the C (collapse) operator (Paper 04’s “Gravity as Collapse,” Paper 17, and Addendum 372’s R1: the fold-geometry of gravity is theorem-grade and observation-free), i.e. gravity is geometry, *not* a force. The corpus has these two pieces but never assembled them. This addendum does, and the assembly is exactly the equivalence principle. **(1)** Gravity is geometry, not force. **(2)** By 383 a body’s natural motion is the inertial coast of its conserved invariant; through the gravity-geometry that coast is the geodesic, so a freely-falling body coasts inertially and feels *no* force — it is weightless. Free-fall *is* inertial motion. **(3)** Curvature mimics attraction with zero force: two geodesics parallel on a positively curved space (the boundary S^3) converge — on the 2-sphere two meridians at separation $d_0 \cos(\text{lat}) \rightarrow 0$ at the pole — so “gravitational attraction” is geodesic convergence, geometry not force. **(4)** The invariant that coasts (inertial mass, 383) is the *same* conserved invariant moving through the *same* fold geometry that *is* gravity (P04/372): one invariant, one geometry, so inertial and gravitational mass are the same object — structurally equal. **(5)** The “weight” felt at rest is the surface (S^3) pushing the body off its geodesic, a real normal force; gravity is what one feels the *absence* of in free-fall. **Honest scope:** the gravitational coupling magnitude is refuted/tipped (372 R3), so the *numerical* equivalence (Eötvös, $\sim 10^{-13}$) is not derived — only the structural one; and the corpus had no explicit equivalence-principle treatment, so this is a new connection, a structural reading. All claims pinned by `verify_P384.py` (8/8).

1 Free-fall is the inertial coast

Proposition 1.1 (Gravity is geometry; free-fall is inertial). *Gravity, in the corpus, is the fold/self-lensing geometry — the C (collapse) operator (Paper 04, Paper 17), whose fold-geometry is theorem-grade and observation-free (Addendum 372, R1: the black hole is degenerate self-lensing, mapping to Schwarzschild). There is no gravitational force term; the “pull” is the shape of the geometry. By Addendum 383 a body’s natural motion is the inertial coast of its conserved invariant. Through the gravity-geometry that coast is the geodesic: a freely-falling body coasts inertially along the fold geometry and feels no force — it is weightless. Free-fall is therefore inertial motion, which is the core of the equivalence principle.*

Theorem 1.2 (Curvature mimics attraction with zero force). *On a positively curved space two geodesics that start parallel converge (geodesic focusing) with no force between them. On the unit 2-sphere, two meridians parallel at the equator have metric separation $d_0 \cos(\text{lat})$, which decreases monotonically to 0 at the pole: the bodies “fall together” by curvature alone. Since the corpus*

boundary S^3 is positively curved, “gravitational attraction” is geodesic convergence — geometry, not force. The attraction is real and the force is absent simultaneously, which is precisely the equivalence principle’s geometric content.

2 Inertial mass is gravitational mass

Corollary 2.1 (Structural equivalence of the two masses). *The invariant that coasts — the inertial mass of Addendum 383 — is the same conserved invariant moving through the same fold geometry that is gravity (Paper 04/372): the gravitational mass. One invariant, one geometry: the two masses are the same object, hence equal. This is the equivalence of inertial and gravitational mass, read structurally. Relatedly, the “weight” felt at rest on a surface is the surface (the boundary S^3) pushing the body off its geodesic — a real normal force — so weight is what one feels the absence of in free-fall, not gravity itself.*

Remark 2.2 (Honest scope: the magnitude floor and the new connection). Two limits. (i) The gravitational coupling *magnitude* is refuted/tipped (Addendum 372, R3: Paper 17’s $\mu_1/3\pi/20$ derivation of G/M_{Pl} is refuted in Paper 40), so the *numerical* equivalence of inertial and gravitational mass — the Eötvös result at $\sim 10^{-13}$ — is not derived. Only the *structural* equivalence is: gravitational motion is inertial motion because gravity is geometry. Form derived, magnitude a floor, the same posture as the H_0 work. (ii) The corpus has no explicit equivalence-principle, geodesic, or free-fall treatment; this addendum assembles the principle from existing pieces (gravity is geometry, 372/P04; inertia is the coast, 383). It is a structural reading, not a previously-stated corpus theorem.

Status

Pulling the inertia thread of Addendum 383 reaches the equivalence principle, which the corpus had the pieces for but never assembled. Gravity is the fold-geometry / the C -collapse operator (Paper 04/Paper 17/372-R1), not a force; by 383 a body coasts inertially through it, so free-fall is the inertial coast — a geodesic, weightless (Proposition 1.1). Curvature mimics attraction with zero force: geodesics converge on the positively curved S^3 (Theorem 1.2). The invariant that coasts (inertial mass) is the same one the geometry bends (gravitational mass), so the two are structurally equal (Corollary 2.1); the weight felt at rest is the surface pushing the body off its geodesic, not gravity. **Honest scope** (Remark 2.2): the numerical equivalence is a floor (372’s magnitude refutation), and the corpus had no explicit equivalence principle — this is the new connection, a structural reading. No published number changes. Verifier: `verify_P384.py`, 8/8 pass.