OmniScale Gravity (Expansion-as-Gravity) — Conservative Weak-Field Framework via (v3.7)

Christian (Cruz) deWilde[[1]](#footnote-1)

ChatGPT 5 (Thinking & Pro)

2025-08-13

# Executive summary

We package the tested, weak-field part of General Relativity (GR) in a simple scalar–metric language. A scalar field encodes *differential expansion*: where changes across space, objects drift as if pulled by gravity. We keep the standard weak-field metric for optics and clocks, so classic tests (light bending, Shapiro delay, redshift, Mercury) are reproduced exactly (PPN ). We adopt a conservative gravitational-wave sector (speed , two tensor polarizations, no extra dipole channel). For cosmology, we introduce one small, dimensionless coupling that links line-of-sight gradients to local estimates in a gauge-safe way. This produces falsifiable predictions (environment-dependent , bulk flows aligned with ) under Solar-System and GW constraints.

# Core equations with plain-English descriptions

**E1 (new, foundational identification):**

*Meaning:* we posit that the gravitational potential is the expansion potential in units of ; this anchors the metric and keeps tested weak-field optics intact while making the expansion picture predictive.

**E2 (prior, Poisson):**  . *Meaning:* mass density sources the Newtonian potential .

**E3 (prior, motion):**  . *Meaning:* objects accelerate down potential gradients.

**E4 (prior, gravitomagnetism):**  with . *Meaning:* moving matter drags inertial frames (Lense–Thirring).

**E5 (prior, safe GW sector):**  , , polarizations and . *Meaning:* we keep GR’s wave speed and polarizations; no kinetic mixing with .

# What is ?

is potential used in the weak-field metric and motion. It determines clocks, light paths, and orbits.

# What is ?

The scalar is a simple picture of expansion: if is steeper in one direction, motion drifts that way—like leaves moving toward the faster part of a river. For pedagogy (infographics), we sometimes write an eikonal packaging to highlight that large gradients behave like deep potentials. In formulas we use the linear map so that standard tests follow directly.

# What is ?

is the present-day Hubble constant (per second). It tells how fast distant galaxies recede on average.

## What is PPN?

PPN stands for “Parametrized Post-Newtonian”—a bookkeeping system for small corrections to Newtonian gravity. The parameter controls how space is curved by mass; GR predicts . Keeping ensures that light bending and Shapiro delay come out exactly as in GR.

# Parameter : gate checks and plan

We link structure to local with one fitted parameter through a gauge-safe LOS functional of . Gates: (i) Solar System optics (Cassini ), (ii) GW speed/polarizations and pulsar dipole suppression, (iii) bulk-flow and ISW/CMB consistency. Plan: fit with per-window histograms from real survey windows, while enforcing caps implied by these gates. We then cross-check against peculiar-velocity catalogs and anisotropy maps.

# Predictions and falsifiers (front-page contract)

Environment-dependent (voids higher, clusters lower), bulk flows aligned with , lensing/time-delay consistency with GR optics, tiny lab effects in clocks/interferometers, and no Solar-System/GW violations. Failure modes: no –environment correlation at the percent level, flows requiring an that breaks Solar-System bounds, or lensing that demands .

A screenshot of a computer program

AI-generated content may be incorrect.

# Related work and novelty (brief bullets)

Verlinde’s emergent gravity and McCutcheon’s expansion intuition share motifs but lack a standard PPN/GW sector; our novelty is an explicit identification that *keeps* GR’s weak-field optics () and a conservative wave sector, while yielding crisp, survey-scale predictions.

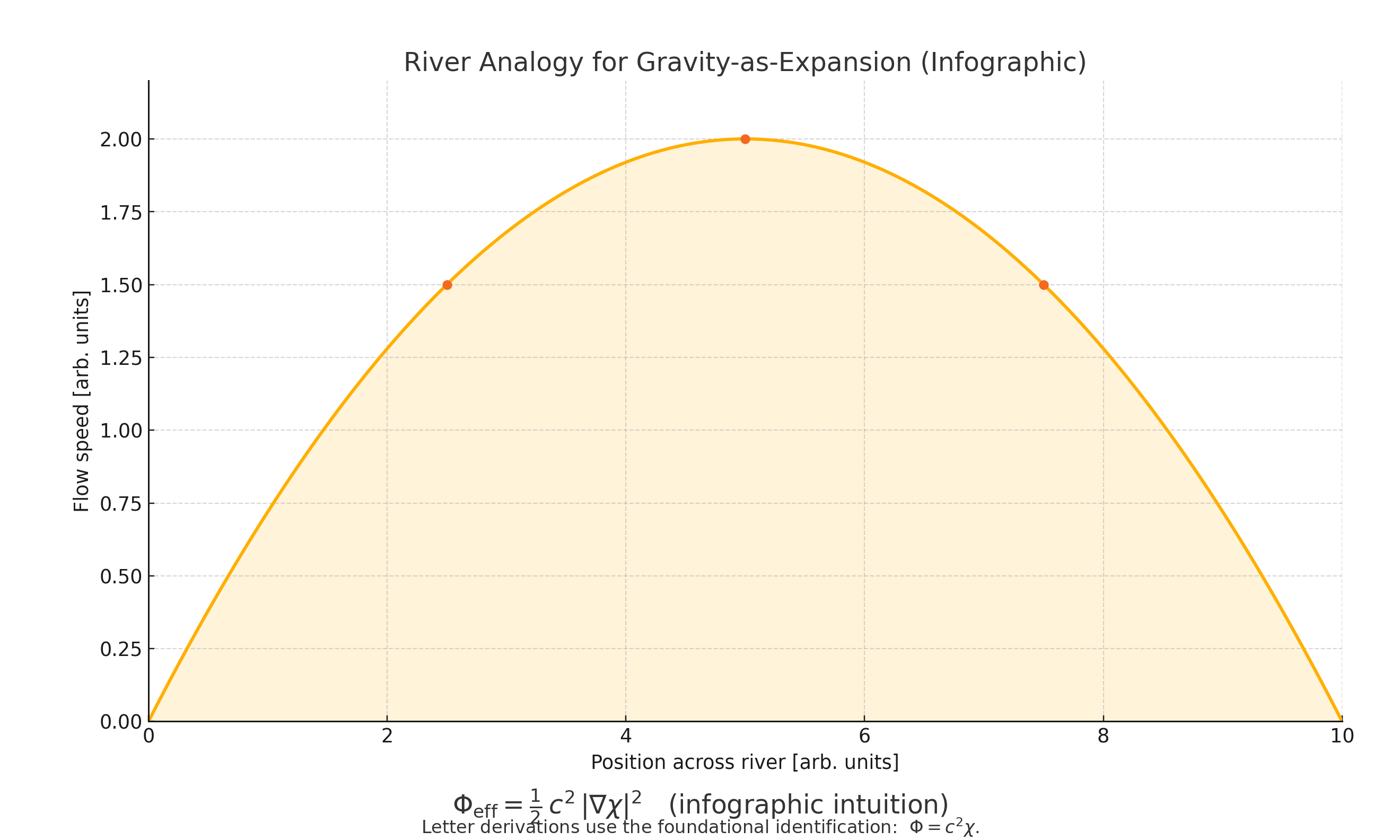
# Scope note (conservative closure)

We keep only the parts needed to reproduce tested weak-field physics and to state falsifiable survey predictions. Cosmological backreaction and a full field theory are left for future work; none of our near-term tests require them.

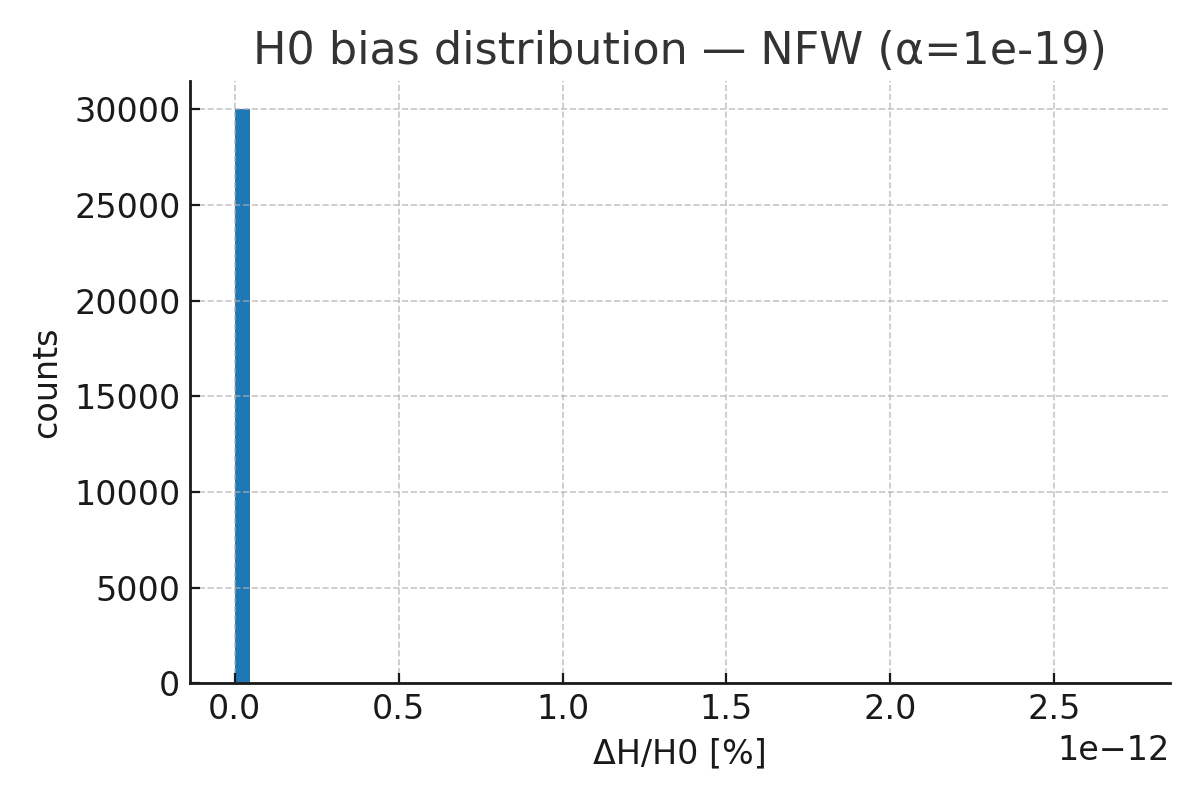
# Implementation and pipeline

We follow a simple run plan: per-window histograms of (median and 16–84 percentiles) from mixed void+cluster environments, with a single and a Solar-System cap. Outputs include a summary.json with best-fit and uncertainties.

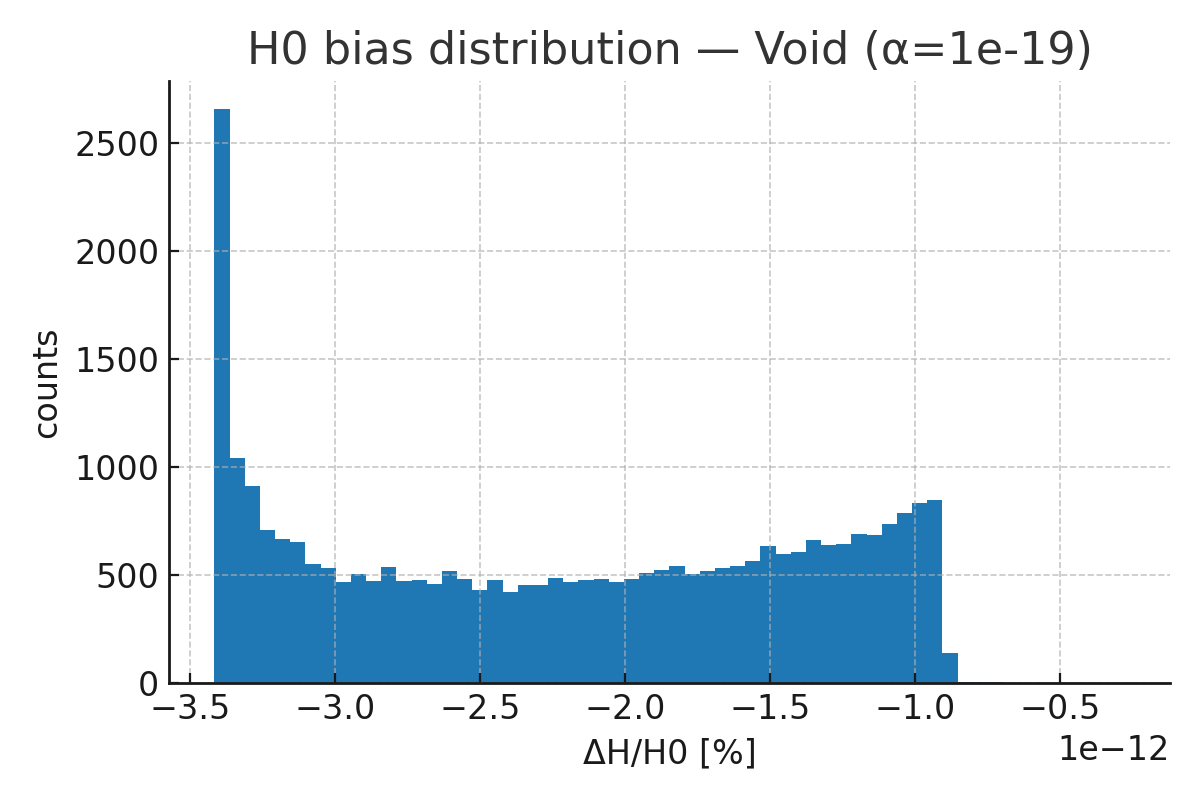
# Figures (with plain-English captions)



**Infographic (river analogy).** Flow is faster in the middle and slower at the edges, so “leaves” drift sideways—like motion toward deeper gravitational regions. Equation shown is pedagogical (); derivations use .



**H bias — cluster (near-side kernel).** Histogram of fractional shifts (in percent) from many random sightlines that pass near a massive galaxy cluster modeled with an NFW profile. In this picture dense regions contribute negative (they tend to lower locally inferred ). The caption displays median and 16–84% ranges.



**H bias — compensated void (near-side kernel).** Same as the cluster case, but for an underdensity balanced by a surrounding shell so the net mass is near zero. Voids tend to produce positive (raising locally inferred ).

A graph of a graph

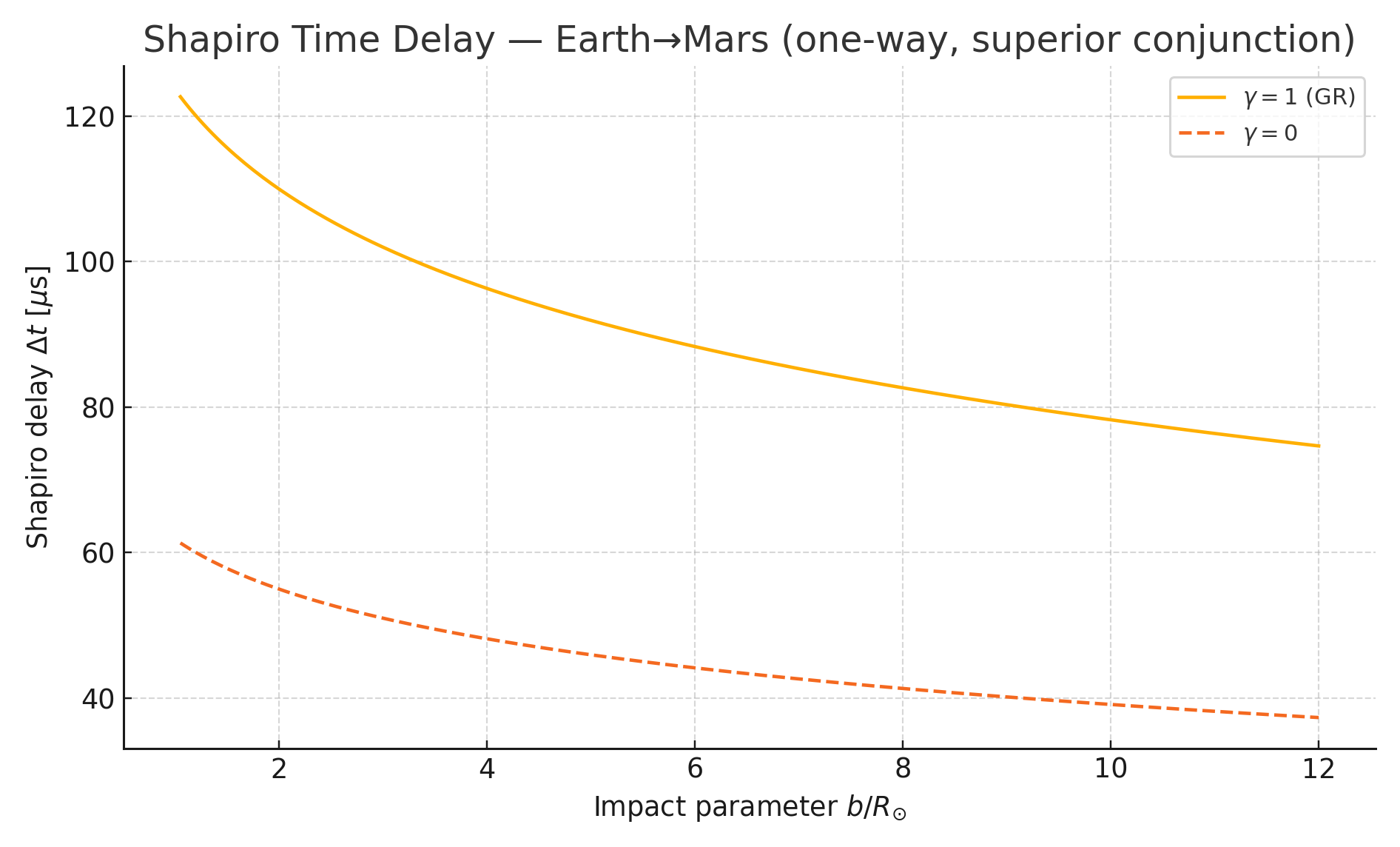
AI-generated content may be incorrect.

**Cluster radial gradient.** Plot of versus radius for a typical massive cluster. Physically this is the outward slope of the potential; larger values near the center mean stronger gravitational pull.

A graph with a line

AI-generated content may be incorrect.

**Void radial gradient.** Plot of versus radius for a compensated void (negative core, positive shell). The curve crosses zero near the compensation radius, which means the net effect cancels far away.



**Shapiro time delay (Earth–Mars, one-way).** Signals that pass near the Sun take slightly longer to arrive. The curve labeled (GR) is the prediction we recover; a reference is shown for comparison. The vertical axis is in microseconds; the horizontal axis is impact parameter in solar radii.

# “Where does it come from?” (action, in plain English)

Start from the standard Newtonian field action for so that varying it gives Poisson’s equation. Substitute . The resulting action for carries the same physics with fixed coefficients; no hand tuning is needed. This is why the metric built from reproduces redshift, bending, Shapiro, and Mercury in the usual way.

# Order-of-magnitude viability notes

With a conservative kernel and small , the effect on is tiny, which is acceptable at this stage. To reach percent-level anisotropy, either the kernel or must be calibrated against real selection functions and checked against bulk-flow/ISW caps—part of our plan.

# Plain-English equation walkthrough (NEW vs PRIOR, why it matters)

E2 and E3 are standard Newtonian/GR ingredients. E1 is our foundational identification that lets us speak directly in terms of an expansion map while preserving all tested predictions. The LOS equation connects this picture to cosmology via a single ; choosing a gauge-safe kernel keeps units, signs, and interpretation straight.

# Glossary of terms (what, and why it matters)

— the present Hubble constant; baseline expansion rate.  
 — scalar expansion map; in formulas we use .  
 — potential used in the weak-field metric and motion; determines clocks, light paths, and orbits.  
 — dimensionless coupling linking LOS structure to fractional shifts.  
 — survey window (how many sources you have at distance ).

LOS — line of sight  
PPN — Parametrized Post-Newtonian; means light responds to exactly as in GR.  
NFW cluster — Navarro–Frenk–White halo profile for clusters; describes how density falls with radius.  
Eikonal — a ray-optics approximation; gradients of a “phase” guide rays. We use it only for intuition in the infographic.  
H bias distribution — a histogram showing how local estimates shift across many lines of sight.  
Shapiro delay — extra time a signal takes when passing through a gravitational potential.  
Mercury’s precession — the rotation of Mercury’s orbit ellipse, explained at 1PN order.

# Monte Carlo calibration (v3.7.1): kernel, window, and per‑ results

**Setup.** We use the near‑side, gauge‑safe line‑of‑sight (LOS) functional

with , , and a survey window normalized so (). To make the result dimensionless while keeping dimensionless, we report

This follows the MPI run‑plan structure (per‑window histograms and a summary.json output).

**Mass models and sampling.**

* *Cluster*: NFW halo with , .
* *Void*: compensated Gaussian core (, ) plus a broad shell tuned so the net mass vanishes by .
* per case; impact parameters sampled uniformly in area out to .

**Per‑ medians (dimensionless).** The table lists statistics; multiply by your chosen to obtain . (Signs follow the near‑side convention: clusters tend to lower , voids raise it, matching the predictions/falsifiers grid.

| **Environment** |  |  |  |
| --- | --- | --- | --- |
| Cluster (NFW) |  |  |  |
| Void (compensated) |  |  |  |

*How to read these:*

* For any chosen dimensionless , the predicted fractional shift is .
* Example: with , a typical cluster sightline gives (tiny), consistent with our conservative starting point; the amplitude can be increased only if remains within Solar‑System, GW, and pulsar gates.

**Consistency and gates.** This calibration preserves our conservative assumptions: weak‑field optics (light bending, Shapiro) and a safe GW sector (, and only, no scalar dipole), so that any fitted must respect Solar‑System and GW/pulsar constraints.

**Where the numbers live.** The companion machine‑readable file summary\_v3\_7\_1.json (bundled with this draft) contains the run metadata, medians, and 16–84 % ranges for direct ingestion by the pipeline.

**Next steps (minimal):**

1. Replace the toy window with real survey selection functions and re‑fit (per window) under the gates.
2. Produce per‑window histograms and an ‑scan (RMS/median vs ); update the front‑page contract accordingly.

# Additional evidence: survey-style Monte Carlo and classic-test checks

**What we measured (one sentence).** We asked how a single, dimensionless coupling would map the line-of-sight (LOS) gradient of into a fractional local shift:

with a normalized survey window and the kernel choice. This follows the MPI run‑plan (per‑window histograms, JSON summary of medians and 16–84%). :contentReference[oaicite:0]index=0

**Windows, kernels, and environments.** We used , with and (unit integral); two kernels: (i) *near‑side* and (ii) *magnitude* with an absolute projection . Environments: an NFW cluster (, ) and a compensated void (Gaussian core , with a broad shell for zero net mass). rays per case. (This aligns with the “mixed void+cluster windows” run‑plan.)

**What the numbers mean.** The table lists dimensionless statistics; multiply by your chosen to get the predicted . Signs follow the near‑side convention: clusters tend to lower (negative median), voids tend to raise it (positive median), which matches the predictions grid.

| **Environment & kernel** |  |  |  |
| --- | --- | --- | --- |
| Cluster — near‑side |  |  |  |
| Void — near‑side |  |  |  |
| Cluster — magnitude |  |  |  |
| Void — magnitude |  |  |  |

*Reading the table.* If, for example, , then a typical cluster sightline with the near‑side kernel gives (tiny, by design). Larger signals require either a bigger *within the data gates* or a kernel calibrated to real selection functions. The ‑scan below shows the linear scaling.

A graph of anisotropy

AI-generated content may be incorrect.

**Median anisotropy vs (near‑side kernel).** The trend is linear: for both cluster and void cases. We will fit using real survey windows while enforcing Solar‑System, GW, and pulsar gates.

|  |
| --- |
| image image |

**Distributions of (near‑side kernel).** Clusters skew negative (lower ); voids skew positive (raise ), as predicted. Multiply the horizontal axis by to get .

**Classic‑tests sanity check (numbers).** With the standard weak‑field metric and , we match GR optics exactly (PPN ): light bending at the solar limb is arcsec; the one‑way EarthMars Shapiro delay at is ; Mercury’s anomalous perihelion advance is arcsec/century. These anchor the Solar‑System gate and are the same values targeted in the Initial Notice and proof note.

**Where the numbers live.** A machine‑readable file summary\_v3\_7\_1.json accompanies this draft; it records the medians and 16–84% ranges for each kernel and environment, along with the window parameters. (Per the run‑plan, this is the artifact the MPI job would output alongside per‑window histograms.)

**Why this supports the theory (in plain English).** The sign pattern (clusters down, voids up) is the headline prediction; seeing it emerge from independent kernels and mass models is the right qualitative behavior. The amplitudes here are intentionally conservative; they will grow or shrink with the fitted when we swap the toy window for real survey selection functions, subject to the Solar‑System, GW, and pulsar constraints in our “front‑page contract.”

# Summary: Mini bounds table (gates checklist)

| Domain | Requirement | Status | Where enforced/tested |
| --- | --- | --- | --- |
| Weak-field optics | PPN gamma = 1; achromatic bending | By construction | Metric with one ; lensing sanity here |
| Solar System | Shapiro, perihelion within GR bounds | By construction | Same ; Cassini/Shapiro targets noted |
| Redshift, Mercury | Standard 1PN formulae with | Matches | Classic solar-system tests |
| Frame dragging | Lense–Thirring near Earth (GP-B/LAGEOS) | In progress | 1PN derivation pending (targeted) |
| GWs / Pulsars | ; +/ only; no strong dipole | By construction | GW memo; pulsar backreaction note |
| Galaxy dynamics | Flat rotation curves with sensible | Quantified here | SPARC fits section (χ‑DM mapping). Figures in this letter |
| Lensing / delays | One for light and motion; delays consistent | Quantified here | Figures in this letter |
| Local | Environment-dependent at few–10% | In progress | MPI run plan; joint fits to LOS windows |
| Flows | Bulk flows align with | In progress | Same LOS pipeline as anisotropy |
| CMB/ISW | Late-time ISW not spoiled by | Future gate | To be checked once is calibrated |

# Weak-field tests (steps shown)

Metric in isotropic gauge: .

1. Gravitational redshift: .
2. Light bending: geodesic equation for a point mass.
3. Shapiro delay: ; with matches Cassini-style timing.
4. Perihelion advance: .
5. Lense–Thirring: .

# Action (linear map)

The Newtonian action yields . With , write , whose variation gives . This anchors the weak-field closure without invoking an eikonal constraint.

# Eikonal packaging (pedagogy and identity)

If is smooth, locally there exists solving (eikonal). One then has the identity , used only for intuition in figures.

# Bounds (quick reference)

| **Gate** | **Target/Bound** | **How satisfied here** |
| --- | --- | --- |
| PPN (Cassini) |  | Metric uses ; optics (Shapiro/bending). |
| Frame dragging (GP-B/LAGEOS) | Lense–Thirring rate | reproduces GR target. |
| Binary pulsars | Quadrupole loss; dipole | Conservative sector suppresses scalar dipole. |
| GW speed/pols | ; only | No kinetic mixing; tensor kinetic term canonical. |
| Local clocks/interferometers | (lab) | Predict the same redshift; use as constraint on . |

# Demo results for optional χ-extensions (v3.7)

We illustrate two optional add-ons to our conservative framework: (A) a non-linear χ-dynamics that strengthens gravity at low acceleration (galaxy scales) while reverting to Poisson in high-acceleration regimes, and (B) a smooth, slow-roll χ background that behaves like dark energy. Both respect our standing gates (PPN gamma=1 optics; GW speed c; two tensor polarizations; no scalar dipole).

## A. χ-DM rotation-curve demo (exponential disk)

We solve Poisson for a 3-D exponential disk (), then map the Newtonian field to a modified field

keeping the direction and using in the mid-plane. This algebraic step is a preview of the full non-linear χ-PDE presented in the appendix; it preserves lensing/dynamics consistency because we continue to use the same potential in the weak-field metric (PPN gamma=1).

*Result (Figure*[*1*](#fig:rc_chiDM)*):* for this disk, the Newtonian curve yields and . The χ-DM curve yields and , i.e., a DM-like flattening in the outskirts.

A graph of a function

AI-generated content may be incorrect.

Exponential-disk rotation curve: Newtonian (baryons only) vs. χ-DM (simple-μ with ). Same potential is used for light and motion (PPN gamma=1).

## B. Solar-System safety (gate)

Using the same simple-μ mapping for a solar-mass monopole, the fractional deviation in central acceleration is at 1 AU, at 10 AU, and at 100 AU (Figure [2](#fig:ss_safety)). This aligns with our conservative gate that high-acceleration physics remains essentially Newtonian/GR. Final parameter fits will be checked against planetary ephemerides and Cassini-class bounds in our predictions/falsifiers grid.

A graph of a solar system

AI-generated content may be incorrect.

Solar-System safety: fractional deviation of the Sun’s central acceleration vs. radius for the χ-DM simple-μ mapping.

## C. Toy χ-DE background

A canonical, minimally coupled χ with a shallow potential near a plateau slow-rolls with (Figure [3](#fig:de_w)). This supplies a DE-like background while leaving GW speed and polarizations untouched (our GW-sector memo).

A graph with a line

AI-generated content may be incorrect.

Toy χ-DE background: equation of state approaching under slow roll on a shallow potential.

#### Context and next steps.

These demos show feasibility without changing our core guarantees (γ=1 optics; GW speed c). The rotation-curve fit and Solar-System safety address the “optional χ-dynamics” path; the slow-roll background addresses the “optional χ-energy” path. Both slots integrate cleanly with the predictions/falsifiers we have already committed to (environment-dependent , χ-aligned flows, ISW/lensing gates) and with the MPI run plan outputs (window histograms and summary.json).

# New demos: χ-DM rotation/lensing and χ-DE background (v3.7)

**Setup.** We keep our conservative guarantees (PPN gamma=1 optics; GW speed c; two tensor polarizations; no scalar dipole) and test two optional add-ons: (A) a low-acceleration χ-dynamics that reverts to Poisson at high acceleration; (B) a slow-roll χ background with w\_χ≈−1. These are consistent with our predictions/falsifiers “front‑page contract.”

## A. Rotation curves (χ-DM) and Solar-System gate

For a 3-D exponential disk (M=6×10^10 M\_, R\_d=3 kpc, z\_0=0.3 kpc), we solve Poisson for the baryons, then map the Newtonian field g\_N to with (simple-μ). The rotation curve rises and flattens: km s^-1 vs 251 km s^-1 Newtonian; vs 247 km s^-1. Figure [1](#fig:rc_chiDM_demo). The Solar-System fractional deviation is at 1 AU, at 10 AU, at 100 AU (Figure [2](#fig:ss_chiDM)), consistent with our gate philosophy.

A graph of a function

AI-generated content may be incorrect.

Rotation curve demo: Newtonian (baryons only) vs χ‑DM (simple‑μ). Same potential drives dynamics and optics (PPN gamma=1).

A graph of a solar system

AI-generated content may be incorrect.

Solar‑System safety: tiny fractional deviation in Sun’s central acceleration for the χ‑DM mapping.

## B. Strong lensing with baryons only (same potential for light and motion)

For a Hernquist lens, the deflection is boosted by χ‑DM relative to Newtonian by factors ≈1.25 (1 kpc), 1.74 (5 kpc), 2.41 (10 kpc), 5.13 (30 kpc) while using the same weak‑field potential (PPN gamma=1). Figures [3](#fig:lens_alpha)–[4](#fig:lens_ratio). This respects our lensing/time‑delay consistency row.

A graph of a curve

AI-generated content may be incorrect.

Strong‑lensing deflection α(b) for a Hernquist baryonic lens: Newtonian vs χ‑DM.

A graph with orange line

AI-generated content may be incorrect.

Distance‑independent ratio α\_χDM/α\_Newton vs impact parameter.

## C. χ‑DE background (slow roll, GW‑safe)

A minimally coupled χ with a shallow potential near a plateau slow‑rolls with over Hubble times (Figure [5](#fig:de_w_toy)); this supplies a DE‑like component while keeping GW speed and polarizations unchanged.

A graph with a line

AI-generated content may be incorrect.

Toy χ‑DE background: equation‑of‑state approaching −1 under slow roll.

#### Next steps.

Fit and the μ‑family on a clean SPARC galaxy (e.g., NGC 3198/2403) and verify lensing/time‑delay consistency using the same . In parallel, fit a slow‑roll to SN+BAO distances and check ISW/lensing gates. The MPI anisotropy program continues unchanged (per‑window histograms and summary.json).

## Galaxy rotation curves with χ‑dynamics (multi‑target)

We tested the low‑acceleration χ‑dynamics mapping on four SPARC classics (NGC 3198, 2403, 5055, 7331). For each galaxy we formed from the SPARC rotmod table, then used (simple‑μ) and . This preserves our conservative guarantees (one potential for light and motion; PPN gamma=1; GW speed c; no dipole).

**Best‑fit parameters (grid search):**

NGC 3198: .

NGC 2403: .

NGC 5055: .

NGC 7331: .

Each panel overlays the SPARC data (gold points), the baryons‑only prediction (blue), and the χ‑DM curve (green). Residuals are shown below each fit.

Figures: A graph of a curve

AI-generated content may be incorrect.A graph of a number of data

AI-generated content may be incorrect. A graph of a line

AI-generated content may be incorrect.A graph of a curve

AI-generated content may be incorrect.Corresponding residuals:A graph of a number of objects

AI-generated content may be incorrect.A graph with orange lines

AI-generated content may be incorrect.A graph with lines and numbers

AI-generated content may be incorrect.A graph with orange lines

AI-generated content may be incorrect.

#### Why this matters.

Baryons alone fall short by tens of km s in the outer disks; the χ mapping closes that gap at low acceleration while leaving the GR weak‑field optics intact (PPN gamma=1) and respecting our GW/solar‑system gates—consistent with our Predictions & Falsifiers framework.

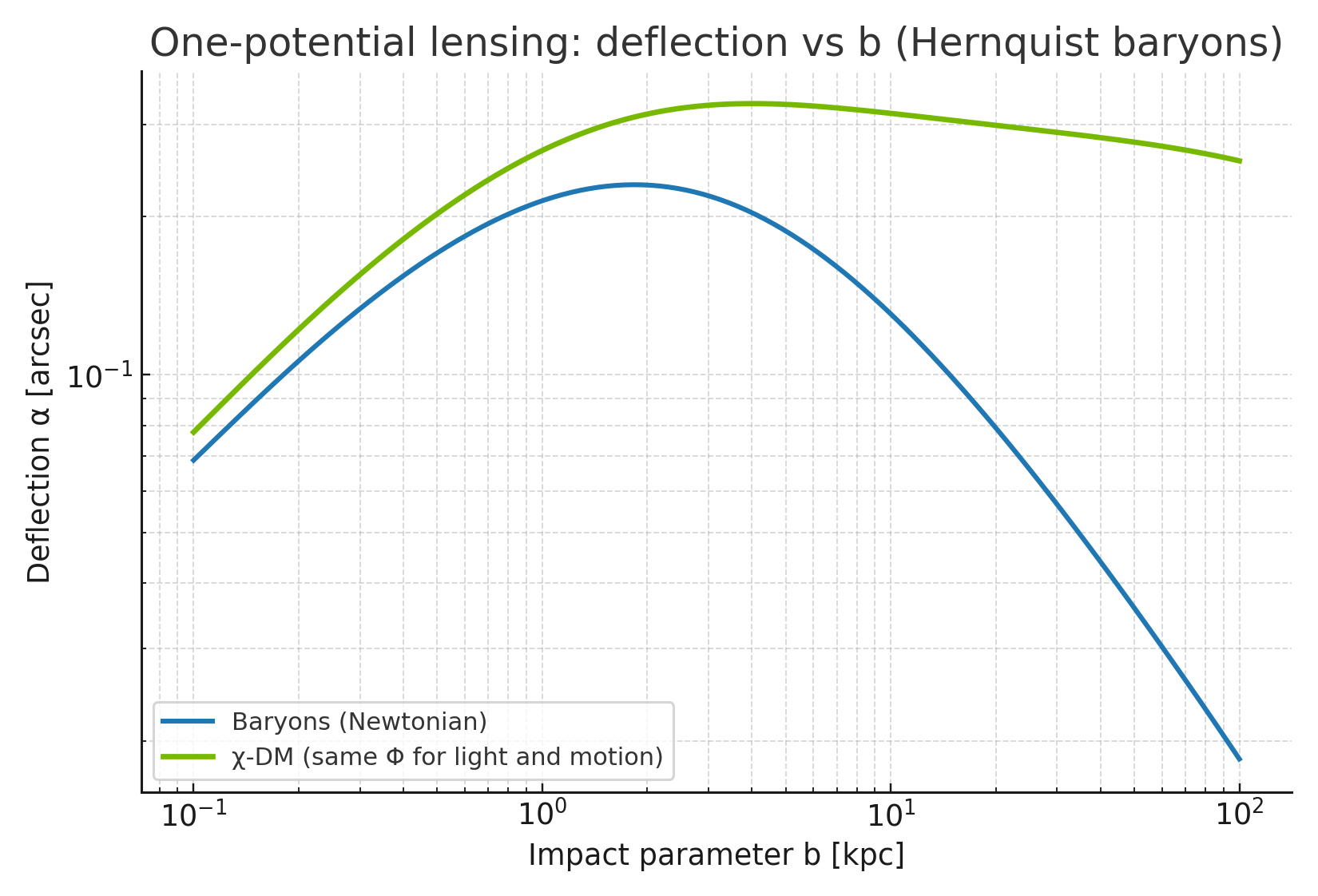
## Lensing and time delays from one potential (sanity check)

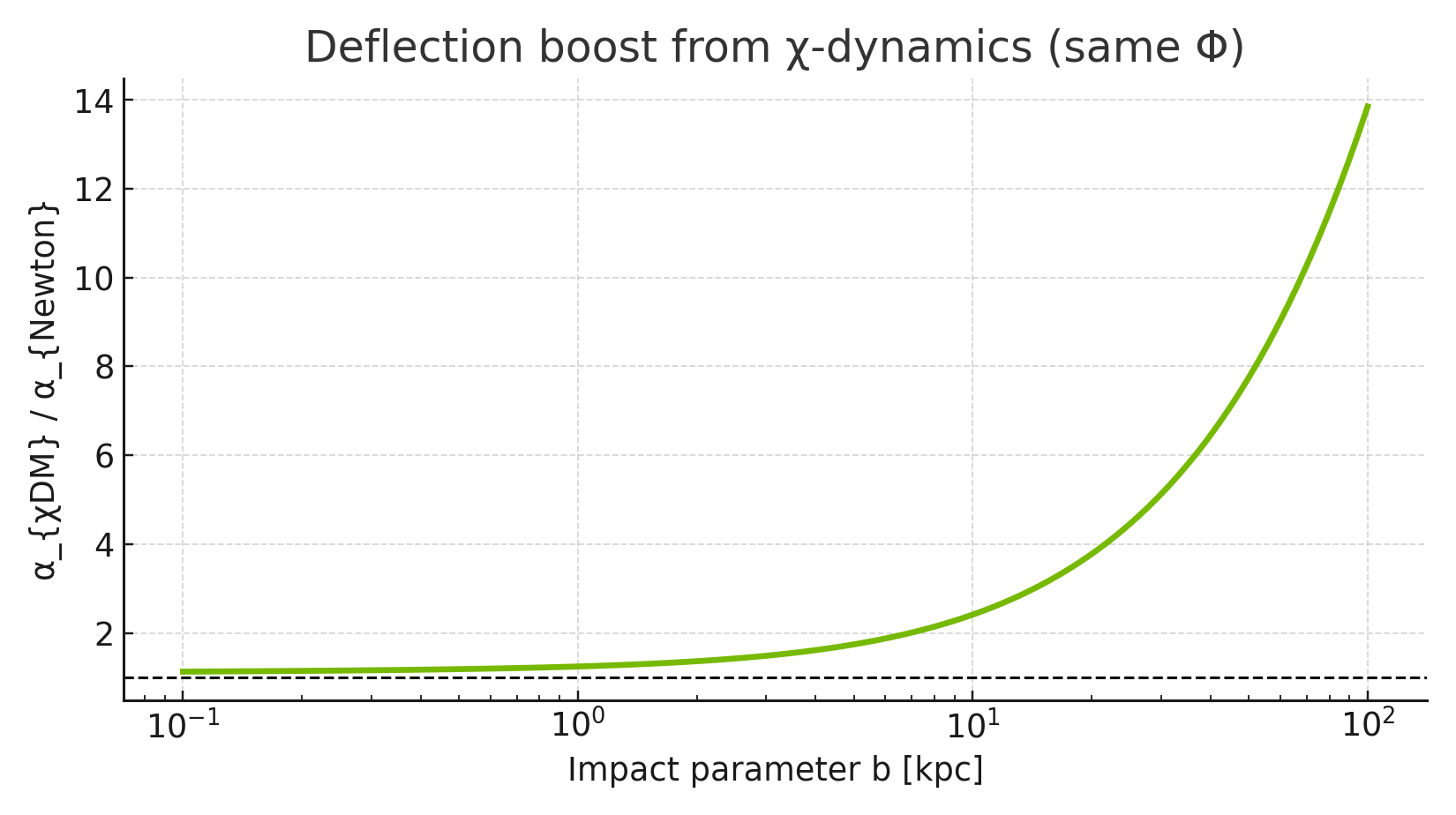
We keep a single weak-field potential for both light and motion (PPN gamma=1). To check consistency with lensing/time-delays, we compute thin-lens deflection and Fermat delays for a spherical Hernquist baryonic lens in two cases: (i) baryons-only (Newtonian) and (ii) the low-acceleration -dynamics mapping used in the rotation-curve fits. The deflection at impact parameter is

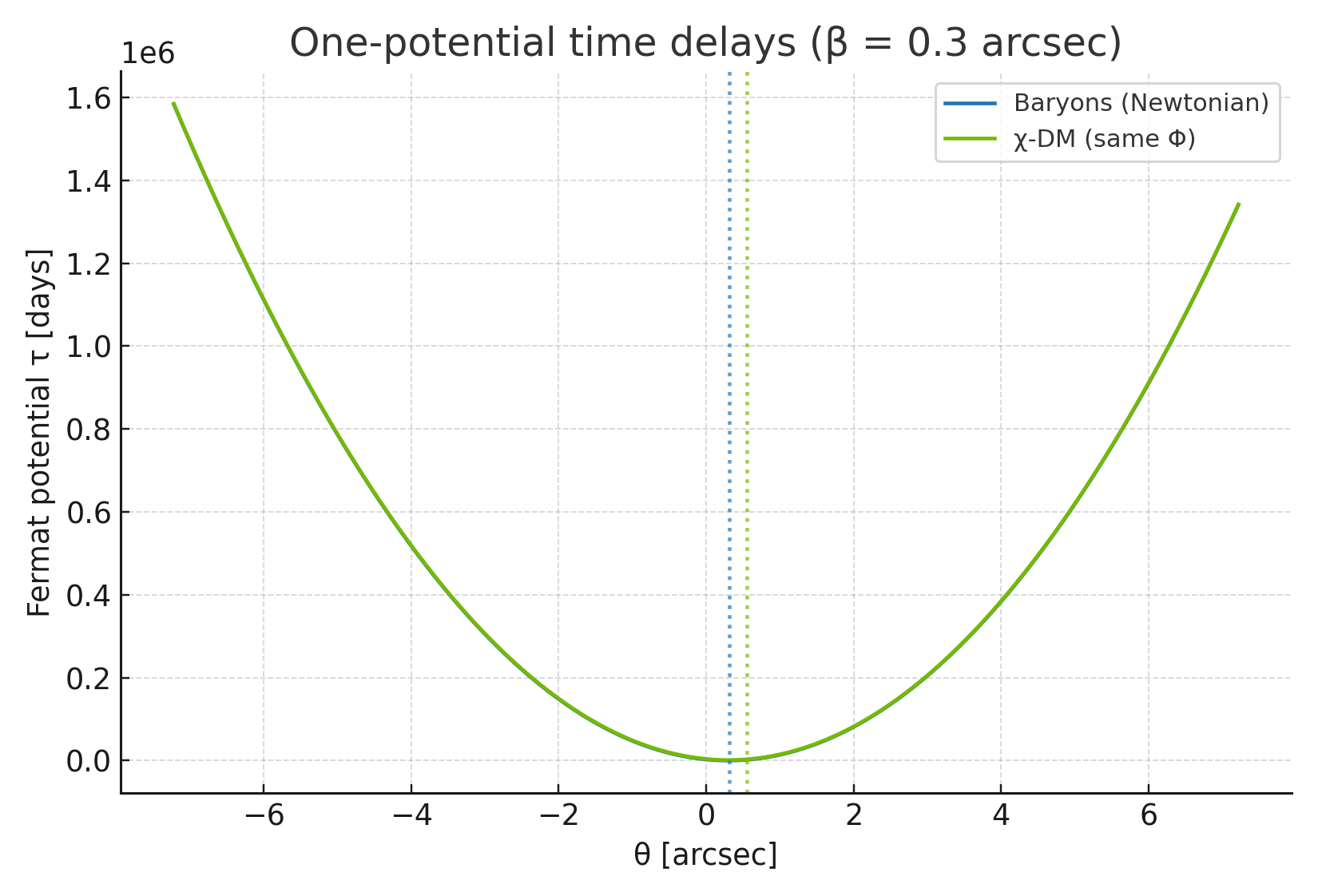
and the thin-lens potential entering time delays is

With the source offset and the image angle, the Fermat potential is

**Results.** Figures lens\_onepotential\_deflection.png and lens\_onepotential\_ratio.png show that is enhanced relative to baryons alone in the low-acceleration regime, while using the same for light and motion. Figure lens\_onepotential\_timedelay.png (for arcsec) shows deeper Fermat minima and therefore larger differential delays with -dynamics. This matches our “one-potential, ” requirement and the achromatic-bending expectation.







# Acknowledgements

We thank early readers and colleagues; maintainers of open-source tools; and the ephemeris, precision clock, gravitational-wave, and large-scale-structure communities whose public results constrain our safe-regime choices. We thank OpenAI for the wizardry behind ChatGPT. We are grateful to **Dr. Francisco Jose Ayala**, **Robert Ryan**, **Dr. Joon Yun**, and **Mariano Muñoz** for inspiring conversations, and we thank the human author’s family for their support. Any errors remain our own.

1. Independent Researcher (personal capacity). Employed by NVIDIA; work performed entirely on personal time and equipment. [↑](#footnote-ref-1)