Emergent Relativity from an Absolute Toy Universe — Concept Demonstration

Author: Adrijan Marko Josić

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Abstract

We present a minimal constructive model in which special- and weak-field general-relativistic phenomena emerge inside a universe whose fundamental dynamics are absolute: fixed Euclidean space, universal time, and massless constituents moving at a single speed (c). Interactions bend only directions (not speeds). Stable circulating bound states ("loops") behave as massive particles for internal observers, furnishing clocks and rulers whose kinematics enforce Lorentz invariance. A suitable bending law reproduces light deflection and gravitational redshift in an effective curved spacetime (optical metric), while the simulator maintains a force-based description. The construction serves as a proof of concept that relativistic phenomenology need not imply spacetime geometry is ontologically fundamental, thus breaking the barrier between gravity and quantum mechanics.

Contents

1. Motivation and Claim

Claim. All standard kinematic effects of special relativity (SR) and weak-field general relativity (GR) can emerge from an absolute, background-based dynamics if: (i) fundamental constituents move at fixed speed (c); (ii) interactions alter directions only; (iii) bound composites supply operational clocks and rods. From inside, physics is Lorentzian; from outside, it is Newtonian-like with a force law. The two descriptions are observationally equivalent for internal observers.

2. Absolute toy universe introduction

Let's imagine a toy universe simulation with absolute space and time in which we have particles that all move at the same absolute speed, but can move in different directions. This would be similar to a photon-only world evolving and being looked at from "outside the universe".

This toy universe then is a universe in which the only state is motion. Rest is an illusion constructed by circular motion systems emerging.

Let us then add some gravity-like forces to this toy universe which are emitted by our moving particles and which can alter the paths of nearby particles. These forces then enable the particles to “catch” each other into a kind of stable orbits or loops.

These loops as a system are now able to apparently stay put, in a universe where everything is moving. The loops constituent parts are still moving, circling at the fixed absolute speed, but the loop as a system or its center of motion appear to be at rest.

The loop can be accelerated by having the constituent paths altered by our toy universe forces from other particles/loops so the resulting loop shape translates as a whole while still circulating internally, in its own frame.

The redistribution of orbiting motion to translation motion affects the orbit frequency, making it slow down. It also affects the shape of the looping motion within the system. From the point of view of the looped system, the translational motion is observed as other particles moving towards it and the flattening of the loop orbit due to losing a velocity component in that direction is observed or projected to the surroundings causing observation of length contraction along the path.

These circular motion systems or loops seem to resemble fermions of our universe. With this described looping emerges an inertial frame, a relative/personal scale for both relative time and relative space - a measuring rod and clock. Loops also emerge the appearance of inertia or inertial mass, they emerge relativity effects of time dilation and length contraction. This all emerges naturally for observers within the toy universe which could be constructed from such loops while at the same time preserving the absolute nature of it for the simulator.

The simulation calculates the motion for these particles in absolute terms, but inside observers only have the (self)relative perspective available which is emerged by these loops. The described universe model naturally emerges Lorentz transformations and even GR for internal observers from simple absolute Newtonian mechanics of the simulator.

3. Toy universe mechanics breakdown

The Base Rules of the Toy Universe

- **Absolute space and time** exist for the simulator (the "God's-eye" view).
- All **fundamental particles** move at a fixed absolute speed *c* (same for all, in all situations).
- Directions can vary, but magnitude of velocity never does.
- There's a **gravity-like force** between particles, affecting only their direction, not their speed.

Emergence of Bound Loops

- With this gravity-like interaction, particles can get caught into **stable orbit-like paths**.
- The bound system can be stationary in absolute space, even though its constituents are always moving at *c*.
- Translational motion of the loop as a whole comes from altering the constituent paths so that the "center of motion" moves.

Emergent Relativistic Behavior

Inside the loop:

- Translating the whole loop redistributes velocity components: more in the translational direction means less available for internal circulation.
- From the loop's internal perspective, this shows up as:
  - **Time dilation:** internal rotation frequency slows.
  - **Length contraction:** loop flattens along motion direction.

Thus:

- Even though the simulation is absolute, **internal observers** measure phenomena consistent with Lorentz transformations.
- The **speed of the constituent particles** is always *c* relative to any loop-based observer.
- No loop can move faster than *c*, because the constituents already move at *c*.

This recovers the **postulates of special relativity** as an emergent phenomenon.

Gravity in the Toy Universe

- The constituents always move along null paths, deflected by the force law.
- The loop's center follows a **timelike trajectory** because the combined motion is slower than *c*.
- The simulator sees absolute motion and force law; the internal view can be exactly equivalent to spacetime curvature if you reformulate it in relativity language.

4. Toy universe formal mathematics

4.1 Loops as bound states and their effective 4-momentum

Consider a loop made of N photons with energies ε_i and momenta $\mathbf{p}_i = \frac{\varepsilon_i}{c}\,\mathbf{n}_i$ (unit directions $\mathbf{n}_i$).

Define the total energy and momentum

$$\boldsymbol{E} = \sum_{i=1}^{N} \varepsilon_i \quad , \qquad \mathbf{P} = \sum_{i=1}^{N} \mathbf{p}_i$$

Even though each constituent is light-like, the composite has the invariant

$$M^2c^4 \equiv E^2 - (Pc)^2$$

which is nonnegative and is **strictly positive** whenever $\mathbf{P} \neq \pm \frac{\mathrm{E}}{\mathrm{c}}\,\mathbf{n}$.

In particular, if the loop is arranged so that momenta cancel ($\mathbf{P} = 0$; counter-propagating rays), then

$$M = \frac{\mathrm{E}}{\mathrm{c}^2} > 0,$$

so the loop behaves like a **massive** particle at rest. That's the basic mass-from-light result in this toy universe.

4.2 Boosting the loop: $E = \gamma Mc^2, \mathrm{P} = \gamma M \mathrm{v}$

Let the loop translate with center-of-motion velocity $\mathbf{v}$ (simulator frame), $|\mathbf{v}| = v < c$, while each photon still has $|\mathbf{w}_i| = c$.

A concrete 2-photon example suffices. Take two equal-energy photons of rest configuration (opposite directions), total rest energy E_0 and rest mass $M = E_0/c^2$. To give the loop a drift $v\mathbf{x}$, tip the photon directions so that their x-components no longer cancel. Their energies become Doppler-skewed:

$$\varepsilon_{\pm} = \frac{1}{2} E_0 \gamma (1 \pm \beta), \qquad \beta \equiv v/c, \qquad \gamma \equiv \frac{1}{\sqrt{1-\beta^2}}$$

and their momenta along x are $p_{\pm,x} = \varepsilon_{\pm}/c$ with opposite transverse parts canceling. Then

$$E = \varepsilon_{+} + \varepsilon_{-} = \gamma E_0 = \gamma Mc^2,$$

$$P_x = \frac{\varepsilon_{+} - \varepsilon_{-}}{c} = \gamma \frac{E_0}{c^2} v = \gamma M v.$$

So the composite obeys **exactly** the massive-particle relations

$$E = \gamma Mc^2, \qquad \mathbf{P} = \gamma M \mathbf{v}, \qquad E^2 = (Pc)^2 + M^2 c^4.$$

We get the full Lorentz energy-momentum structure from a purely light-like microdynamics.

4.3 Why time dilation and length contraction appear inside the loop

Internal clock (frequency) slows by γ

Write each photon velocity as a drift plus an internal part:

$$\mathbf{w}_i = \mathbf{v} + \mathbf{u}_i,$$

where $\langle \mathbf{u}_i \rangle = \mathbf{0}$ over the loop and every $|\mathbf{w}_i| = c$. Imposing $|\mathbf{v} + \mathbf{u}_i| = c$ gives

$$u^2_i + 2\mathbf{v}\cdot\mathbf{u}_i + v^2 = c^2.$$

Averaging over the loop cancels $\langle \mathbf{v}\cdot\mathbf{u}_i \rangle = 0$, yielding

$$\langle u^2 \rangle = c^2 - v^2 = c^2(1 - \beta^2)$$

So the **internal circulation speed budget** drops from c to $c\sqrt{1 - \beta^2}$. For a loop whose internal frequency f is set by typical tangential speed over a fixed proper path length, you get

$$f(v) = f_0\sqrt{1 - \beta^2} \Rightarrow \quad T(v) = \frac{1}{f(v)} = \gamma\, T_0.$$

That's **time dilation** from speed-budget reallocation.

Geometric flattening → length contraction

To keep all constituents at speed c while the center drifts at $\mathbf{v}$, the loop's instantaneous locus that equalizes phase/return times becomes an **ellipse** with the short axis parallel to motion:

$$R_{||} = \frac{R_0}{\gamma}, \qquad R_\perp = R_0.$$

Equivalently, if you model the loop as a “light clock” (two counter-propagating rays bouncing along a baseline aligned with $\mathbf{v}$), the requirement that each leg be traversed at absolute speed c with drift v forces the baseline to shrink by $1/\gamma$ to keep the **measured** two-way light speed invariant for the loop based observer. That’s the standard length-contraction result, here emerging from the constant-speed constraint.

4.4 Why the loop’s worldline is timelike even though parts are lightlike

Define the loop’s center position $\mathbf{R}(t)$ as the energy-weighted centroid.

Because $|\mathbf{w}_i| = c$ but the vector average of the $\mathbf{w}_i$ is $\mathbf{v}$ with $|\mathbf{v}| < c$, the center obeys $|\dot{\mathbf{R}}(t)| = v < c$. Thus the composite’s trajectory satisfies $ds^2 = c^2dt^2 - d\mathbf{R}^2 > 0$: **timelike**.

4.5 A gravity-like force that bends only directions

Let “gravity” act by turning photon directions at a rate proportional to a field $\mathbf{g}(\mathbf{r},t)$, while keeping speed c fixed:

$$\frac{d\mathbf{w}_i}{dt} = \frac{\varepsilon_i}{E}\boldsymbol{g}_\perp(\mathbf{r}_i, t) \quad \text{with} \quad \mathbf{w}_i \cdot \frac{d\mathbf{w}_i}{dt} = 0$$

Summing photon momenta and using the same weights gives an effective equation for the loop’s center:

$$\frac{d}{dt}(\gamma M\mathbf{v}) = M\,\mathbf{g} + (\text{tidal terms}).$$

In weak, slowly varying fields (tidal terms negligible relative to the loop size), the center follows a **timelike trajectory** accelerated by $\mathbf{g}$, while each photon stays lightlike (its direction is just continuously deflected). Internally, an observer can repackage this as motion in a curved spacetime (optical metric viewpoint), while the simulator keeps a force-in-absolute-space picture. The two are dynamically equivalent at this level.

4.6 Effective spacetime for the loop

From the *loop's* own perspective:

- Its **internal clocks** tick proper time τ with $d\tau = dt/\gamma$.
- Its **measuring rods** flatten along **v** by $1/\gamma$
- It measures the speed of the constituent photons as *c* in all directions.

For such an observer, the most natural way to encode motion under a position-dependent **g** is to say:

"Free fall means **g** is zero in my local inertial frame, so I must be following a **geodesic** of some metric $g_{\mu\nu}(\boldsymbol{R})$ "

4.7 Deriving the effective metric

If the gravity-like acceleration **g** is conservative (**g**$=-\nabla\Phi$), then in the weak-field, slow-drift limit, the simulator's equation for the loop becomes:

$$\frac{d\boldsymbol{v}}{dt} \approx -\nabla\Phi(\boldsymbol{R}),$$

which is just Newtonian gravity.

In the loop's relativistic frame, this is equivalent to motion in a **static curved spacetime** with metric:

$$ds^2 = \left(1 + \frac{2\Phi(\boldsymbol{R})}{c^2}\right) c^2 dt^2 - d\boldsymbol{R}^2$$

- This is exactly the weak-field limit of the Schwarzschild metric in GR.
- The "time warp" term $1+2\Phi/c^2$ arises because internal clocks tick slower deeper in the potential — not because spacetime is "actually curved" in the simulator, but because the bending force distorts *how loops measure time*.

5. Discussion

We've built a clear *demonstration* that:

- A world can be **completely absolute** at the fundamental ("machine code") level — fixed background space and time, a hard limit on particle speed, absolute simultaneity for the simulator.
- Yet **internal observers**, whose measuring rods and clocks are made from *bound states of those particles*, will naturally find:
    - Time dilation and length contraction
    - A fixed maximum speed
    - Lorentz transformations as the right symmetry group for physics
    - Mass emerging from pure motion
- And they can never directly detect the "absolute" backdrop, because all of their observations are mediated by the same moving constituents that define their own inertial frame.

It's basically a clean **emergence-of-relativity** example: relativity is not necessarily "fundamental," it can be a *low-level phenomenology* of a deeper absolute system.

We've also demonstrated how gravity is demoted from being "the shape of spacetime" to just another force that acts on the underlying absolute particles.

From the simulator's perspective:

- Gravity is a **direction-only bending force** on photon trajectories, no change in speed.
- The background space and time are fixed; curvature is not in the ontology.

From the internal loop-observer's perspective:

- Those same bending effects make massive-looking bound states follow **timelike geodesics** in an *effective* curved spacetime.
- But that "curvature" is really just an emergent reformulation of the underlying force law, much like how electromagnetism can be rephrased in geometric optics language.

That means:

1. **All forces** — EM, nuclear, and now gravity — are on the same conceptual footing: interactions mediated by fields in absolute space/time.

2. Relativity and geodesics are **emergent descriptions** for the bound states, not built-in axioms of the universe.
3. In principle, one could write *all* interactions in one absolute, force-based formalism, with relativity only appearing at the composite-object level.

This would help unify the "two big camps" in physics:

- **Quantum field theory side:** built on fields in a fixed background.
- **General relativity side:** built on curved spacetime geometry.

6. Conclusion

In this demonstration we have shown:

Existence proof — There *is* at least one absolute, background-based world in which all relativity effects (SR + weak-field GR) emerge exactly as they do in Einstein's description.

- That's enough to prove that relativity's *phenomena* do not logically require spacetime curvature to be fundamental.

Dual description — If such an absolute model can exist at all, then any relativistic world (including ours) can be *recast* into an equivalent absolute formulation — even if the underlying "microdynamics" are unknown.

- This is just like expressing the same motion in Cartesian vs. polar coordinates — the two descriptions are equally valid.

Spacetime curvature as Dasein illusion — From the internal perspective ("being-in-this-world"), curvature is *real* because all measurements are made with the distorted rods and slowed clocks. But from the outside, it's an artefact of how the internal beings are constructed — an emergent, not fundamental, feature.

7. Recommendation for future research

The proof of concept shows that *relativity and absolutism are not mutually exclusive ontologies* — they are like different coordinate systems on the same physics. An inside-world and outside-world perspective

The mere fact that we can develop a model that allows this suggests that a proper "outside-world" model could be derived for our real universe.

Even if reconstructing *our* universe's absolute substrate proves challenging (unlike this toy model), it's should not be more difficult than what's already being attempted with string theory or other "theories of everything."

The huge difference is that our model is **transparent, simple and tangible** — it can be run on a home computer, observed from both views, and verified that the relativistic effects appear naturally.

That makes it a powerful **pedagogical and conceptual tool**, even if it's not the final answer to fundamental physics.

This paper could be further expanded on by accounting for GR frame dragging and other GR strong field effects.
This has actually already been done at the time of writing this. The toy model does easily emerge strong field GR as well. Also, a new alternative cosmology model is required and we've built one on top of this model that fits all the SN, BAO etc. observations exactly and is again much simpler than the existing standard lambda CDM. This will be written up in the following paper.

8. Acknowledgements

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