7/31/25

A New Model of Physics

By Deepak Nanda

Abstract

I propose that our universe is an open physical system within a larger domain, which I call the hyperverse. In this model, energy can leave our universe while dark matter enters from the hyperverse. I also propose that gravitational strength evolves over cosmic time, so the quantity usually written as the constant G is more generally G(t).

Gravitational persistence names a further part of the proposal: spacetime may retain a lasting response to past energy transfer. The purpose of this paper is to connect these ideas without confusing incoming matter, retained gravitational effects, and changes in gravitational strength.

The equations below establish a minimal accounting framework and identify the additional physical laws needed to make predictions. The central tests are galaxy rotation, gravitational lensing, the expansion history, the early universe, and measurements of changes in G. Agreement with those observations remains a result to demonstrate.

Keywords: cosmology; hyperverse; dark matter; energy exchange; gravitational persistence; variable gravitational strength.

1 The central idea

The starting question is whether the contents and gravitational behavior of our universe can be understood fully from processes occurring inside it. My proposal is that our universe exchanges energy and matter with a larger physical setting.

I call our universe a bubble and the surrounding domain the hyperverse. These terms describe the proposed relationship between the two domains. They do not identify the edge of the observable universe as a physical wall. A complete model must specify the geometry of the interface and explain what can cross it.

The proposed exchange has two directions. Energy escapes from our universe into the hyperverse. Dark matter enters our universe from the hyperverse and contributes to gravity here. The exchange may also affect the long-term response of spacetime and the effective strength of gravity. The relation between these effects is the main physical question.

There are several observations to account for. Many galaxies rotate as though they contain more gravitating matter than their visible stars and gas provide. Gravitational lensing independently maps excess gravitational influence, including in colliding galaxy clusters. The cosmic microwave background constrains the matter content and structure of the early universe. In the standard cosmological model, ordinary matter makes up about 5% of the present energy budget, dark matter about 27%, and dark energy about 68%. These proportions are model-based inferences from observations. [1] [2]

Dark energy addresses another observation: the expansion of the universe has accelerated during its recent history. Explaining additional attraction around galaxies and explaining accelerated expansion are distinct requirements, even if both ultimately arise from one underlying process. [3]

My proposal connects these questions through external exchange and gravitational evolution. It does not require us to assume that a quantity measured as steady today must remain unchanged throughout cosmic history. It does require an account of how any changes occur and how they remain compatible with precision observations.

The argument proceeds in three stages: define the exchange, determine its gravitational consequences, and compare the resulting predictions with measurements. A successful model must determine the exchange rates and gravitational response through physical laws, rather than treating every observed discrepancy as an independently adjustable input.

2 How the model works

The notation is kept consistent throughout. Cosmic time is t. The dimensionless scale factor a(t) describes expansion and equals 1 today. The expansion rate H(t) is the time derivative of a divided by a. G(t) is the effective gravitational coupling, and c is the speed of light. Here c and the units of measurement are held fixed.

Every density written as ρ is a mass-equivalent density, measured in kilograms per cubic metre: its energy density is ρ multiplied by c squared. Pressure p is measured in pascals. Consequently, p/c^2 has the same units as ρ. A dot above a quantity denotes its derivative with respect to cosmic time.

The exchange rates Q_{in} and Q_{out} are positive energy amounts transferred per unit physical volume per unit time, measured in joules per cubic metre per second. Dividing either rate by c^2 gives a mass-equivalent density change per second. The subscripts specify the direction relative to our universe.

These definitions organize the proposed flows. They do not yet specify what the hyperverse contains, how the interface works, or what determines either transfer rate. Those are physical ingredients that the completed model must supply.

2.1 Energy leaving and dark matter entering

Cosmological redshift is the starting motivation for energy escape. As a freely propagating photon travels through an expanding universe, its wavelength grows and the energy measured by comoving observers decreases. In standard cosmology, this behavior is already included in the radiation conservation equation. It does not by itself establish that energy crosses into another domain. [4]

My additional hypothesis is a physical outward transfer to the hyperverse. To distinguish that transfer from ordinary redshift, the outgoing rate must appear explicitly in the equations.

For a minimal background example, take the incoming dark matter to be cold, meaning that its pressure is negligible compared with its rest-energy density. Let the outgoing channel draw energy from radiation. In this example, ordinary emission and absorption between matter and radiation are omitted; they can be added as separate internal transfers. Write the dark-matter density as ρ_d and the radiation mass-equivalent density as ρ_r. The mean densities then obey:

$$\begin{aligned} \dot{\rho}_{\mathrm{d}} + 3H\rho_{\mathrm{d}} &= \frac{Q_{\mathrm{in}}}{c^2} \\ \dot{\rho}_{\mathrm{r}} + 4H\rho_{\mathrm{r}} &= -\frac{Q_{\mathrm{out}}}{c^2} \end{aligned} \tag{1}$$

The first line says that incoming dark matter adds to its density while expansion dilutes it. The second says that radiation loses energy through expansion and through the additional outward channel. The factors 3 and 4 differ because radiation experiences both dilution and redshift.

The same radiation equation can be written as:

$$\frac{d}{dt}\left(a^4\rho_{\mathrm{r}}\right) = -\frac{a^4 Q_{\mathrm{out}}}{c^2} \tag{2}$$

This form makes the accounting transparent. With no outward transfer, $a^4\rho_r$ remains constant. A genuine outward transfer makes it decrease. The redshift contribution must not be added again as though it were automatically a second physical escape process.

The incoming-matter equation also gives an accumulated quantity:

$$a^3(t)\rho_{\mathrm{d}}(t) = a_{\mathrm{i}}^3\rho_{\mathrm{d}}(t_{\mathrm{i}}) + \frac{1}{c^2}\int_{t_{\mathrm{i}}}^{t} a^3(t')Q_{\mathrm{in}}(t')\,dt' \tag{3}$$

Here t_i is the chosen initial time, and a_i is the scale factor then. Multiplying by a^3 follows a fixed comoving volume, whose physical volume grows with expansion. The integral adds the dark matter that enters that volume after t_i.

This expression follows by multiplying the first balance equation by a^3 and applying the product rule. Every term has units of mass density. It also shows why continuing inflow can increase the amount in a comoving region even while the density per physical volume decreases.

Q_{in} and Q_{out} have not been assumed equal. A relationship between them must come from the proposed interface physics. If energy escapes through another component, that component needs its own loss term. Describing the universe as open does not, by itself, define a globally conserved total energy for the combined spacetime. [4] [5]

2.2 Gravitational persistence and galaxy halos

In the external-exchange picture, dark matter has a proposed origin outside our universe. Once it enters, its density and motion must be evolved consistently with gravity. Its external origin alone does not establish that it is cold, collisionless, or weakly coupled to light; those properties must follow from its physical description.

Gravitational persistence is a separate proposed response: the influence of past transfer may remain after the immediate event has passed. For this to become a calculable effect, the theory must identify what carries the response, how it propagates, and whether it decays. The present framework leaves that response law open.

This distinction prevents double counting. Incoming dark matter already contributes to gravity. An additional persistent contribution can be included only if the field equations identify an independent effect. Likewise, the same emitted energy cannot be counted in full as both retained inside the universe and transferred outside it.

General relativity has a gravitational-wave memory effect, in which a passing signal can leave a permanent displacement between freely falling test masses. That established theoretical effect provides useful context, but does not by itself supply a stationary dark-matter halo or the persistence law proposed here. [6]

For a spherical system in an approximately Newtonian regime, with G nearly uniform across the system, the circular speed is:

$$v_{\mathrm{c}}^2(r,t) = \frac{G(t)M_{\mathrm{enc}}(r,t)}{r} \tag{4}$$

Here r is distance from the centre and M_{enc} is the gravitating mass enclosed within r. This approximation requires any additional field forces to be negligible or separately included. If those forces matter, the circular speed must instead be calculated from the gravitational potential predicted by the complete theory.

A roughly flat rotation curve requires the enclosed effective mass to grow approximately in proportion to r over the observed radial range. A spherical density falling approximately as the inverse square of r has that property. It is a useful target profile, but assuming it does not explain how hyperverse inflow or persistence creates it.

The model must therefore predict both the quantity of incoming matter and its spatial distribution. That requires more than the mean-density equations in Section 2.1: it requires local motion, transport, boundary conditions, and structure formation.

An energy budget remains necessary if part of a halo is attributed to retained radiation. The available mass equivalent is the retained energy divided by c^2, with the retention fraction specified. External inflow may provide a separate supply, but it must be accounted for explicitly.

Potential signatures include relationships between halo properties and a galaxy’s age, emission history, or environment. Such relationships become predictions only after the transfer and response laws specify their direction and size.

2.3 Cosmic expansion and dark energy

The expansion problem asks whether the proposed exchange can produce the observed acceleration. Adding positive, pressureless matter by itself increases gravitational deceleration in ordinary general relativity. A mechanism that accelerates expansion therefore needs an additional effect on pressure, geometry, or the gravitational field equations. [4]

To state that requirement without choosing an unproved mechanism, write the homogeneous expansion equations in the following form:

$$\begin{aligned} H^2 &= \frac{8\pi G(t)}{3}\rho - \frac{\kappa c^2}{a^2} + F_X(t) \\ \frac{\ddot{a}}{a} &= -\frac{4\pi G(t)}{3}\left(\rho + \frac{3p}{c^2}\right) + A_X(t) \end{aligned} \tag{5}$$

Here ρ and p refer to the explicitly modeled material components in our universe. The curvature parameter κ has units of inverse metres squared because a is dimensionless. F_X and A_X have units of inverse seconds squared and represent corrections that the full hyperverse, persistence, and variable-G dynamics would produce.

These correction terms are names for missing physical calculations. They are not two independent functions that may be chosen freely: the field equations and conservation conditions must relate them. Section 2.5 states the underlying consistency requirement.

Acceleration occurs when the positive contribution from A_X is large enough to overcome the material term in the second line. The sign of the energy flow alone does not determine that outcome. The theory must calculate how transfer affects the geometry.

In the ordinary constant-G limit with no additional corrections, sufficiently negative total pressure can drive acceleration. The proposed framework seeks a physical origin for an equivalent cosmological effect through exchange and gravitational evolution. It does not yet derive that effect or its magnitude.

Comparing radiation densities at two different epochs is insufficient to calculate a present dark-energy density. Expansion changes physical volumes, and any transferred component has its own subsequent evolution. The calculation must integrate the transfer using the appropriate volume factors and response law.

Related braneworld calculations have shown that exchange with a surrounding higher-dimensional region can produce accelerating solutions under specified assumptions. They are useful examples of the mathematical task, rather than evidence that the hyperverse proposed here has been observed. [5]

2.4 Gravitational strength over cosmic time

I propose that gravitational strength evolves on cosmic timescales and is approximately constant over sufficiently short intervals. The present value is G_0, measured at the present time t_0. A convenient definition of its fractional rate of change is $\gamma(t)$:

$$\begin{aligned} \gamma(t) &= \frac{\dot{G}(t)}{G(t)} \\ G(t) &= G_0 \exp\left[\int_{t_0}^{t} \gamma(t')\, dt'\right] \end{aligned} \tag{6}$$

The first line defines γ. The second follows by integrating the first and ensures that G stays positive when G_0 is positive. The exponent is dimensionless because γ has units of inverse time.

If γ changes little during a short interval, the fractional change in G is approximately γ multiplied by that interval. This expresses the idea of slow drift without assuming that the same rate applies throughout cosmic history.

A short observing window cannot prove constancy forever, but instruments can detect changes far below human perception. A lunar laser-ranging analysis reported a fractional drift of $(-5.0 \pm 9.6) \times 10^{-15}$ per year, consistent with zero within its quoted uncertainty. This is a constraint on allowed local drift, not a measurement establishing that G changes. [8]

Incoming matter and changing G have different effects. Inflow changes the amount of gravitating matter. A change in G changes the coupling between a given amount of matter and gravity. Their connection must come from the proposed hyperverse dynamics; the framework does not choose the sign or rate of γ in advance.

2.5 Mathematical consistency

A varying G and an open matter sector require a compatible gravitational description. Simply replacing G by G(t) in the ordinary Einstein equation while keeping all other assumptions unchanged is generally insufficient.

One way to organize an effective four-dimensional description is:

$$\mathcal{G}_{\mu\nu} = \frac{8\pi}{c^4} G(x) T_{\mu\nu} + X_{\mu\nu} \tag{7}$$

The symbol $\mathcal{G}$ is the Einstein tensor, which describes a particular combination of spacetime curvature. It is distinct from the scalar coupling G. T is the stress–energy tensor of the explicitly modeled material components, and X contains the additional geometric or field contributions required by the full theory. X has the same units as the Einstein tensor. Here x denotes a spacetime position; the homogeneous background value of G(x) is G(t).

This equation is a definition of the correction needed in an effective description. It does not supply the dynamics of X. The hyperverse, persistence, and variable-G mechanism must provide those dynamics without counting any contribution twice.

The Einstein tensor has identically zero covariant divergence. Therefore the correction must satisfy:

$$\nabla^\mu X_{\mu\nu} = -\frac{8\pi}{c^4}\nabla^\mu[G(x)T_{\mu\nu}] \tag{8}$$

The derivative symbol here is the covariant derivative, which is the form appropriate to curved spacetime. This relation follows directly by taking that derivative of the previous equation. It states the consistency condition that links changing gravitational strength, material energy transfer, and additional field effects. [4] [9]

In a homogeneous universe, components of X contribute to F_X and A_X in Section 2.3. Those terms must therefore follow from the same field dynamics. Until that relationship is specified, the equations provide a framework for testing a mechanism rather than a completed prediction of dark matter and dark energy.

3 Predictions and observational tests

The framework becomes testable when it predicts the transfer rates, the evolution of G, and the response of spacetime using a common set of physical assumptions. These ingredients must then be used across all observations. A successful fit to one galaxy is not sufficient if the same model fails for clusters, the early universe, or local gravitational measurements.

The following tests preserve the observational questions motivating this proposal while stating what must actually be calculated.

3.1 Galaxy rotation and structure

Rotation curves test the radial gravitational field. The model must predict the amount and distribution of incoming dark matter, together with any independent persistence effect, and compare the resulting speeds with measurements across different kinds of galaxies.

Galaxy scaling relations provide a stricter test than a single flat curve. The baryonic Tully–Fisher relation connects baryonic mass with the fourth power of characteristic rotation speed. The radial acceleration relation connects measured acceleration with that expected from visible matter. The framework must explain these relationships, including their scatter, rather than simply invoke a common dependence on baryons. [7]

Galaxy centres test how matter is transported and redistributed. The core–cusp problem concerns differences between some inferred central density profiles and profiles in simple cold-dark-matter simulations. The presence of a central black hole does not automatically remove a halo or erase its gravitational influence. A prediction involving black holes must calculate capture, transport, and the persistence response.

The original possibility that intense gravitational sinks alter persistence remains a question for the model. It is not assumed to solve the core–cusp problem. Dwarf galaxies and systems without large central black holes are necessary comparisons.

Early galaxies and the growth of structure test timing. If the dark component is supplied through inflow, enough must be present early enough to support the observed development of structure. The initial density and transfer history in the accumulated-matter equation are therefore physical constraints, not merely convenient starting values.

3.2 Gravitational lensing and cluster mass

Gravitational lensing measures how spacetime bends the paths of light. A model that matches orbital speeds must also predict the correct lensing field. In theories with additional gravitational degrees of freedom, the combination of metric potentials governing light can differ from the one governing slow-moving matter. Their relationship must be derived.

The Bullet Cluster is a particularly useful test because much of the hot gas is spatially separated from the gravitational mass inferred from lensing after a collision. The proposed dark component must reproduce the observed distribution and its motion through the encounter. Describing a persistent field as collisionless is not a substitute for an evolution equation. [2]

Weak-lensing surveys and cluster dynamics test the same ingredients across larger environments. They can reveal whether an inflow model makes halos too diffuse, too centrally concentrated, or too dependent on recent activity.

A possible additional test concerns changing sources. If a brightening galaxy or quasar alters the transfer rate, the model may predict a subsequent change in its gravitational field. The response time, amplitude, and spatial pattern need to be calculated before such an observation can support or exclude the proposal.

3.3 Expansion and the early universe

Distance measurements from supernovae, patterns in galaxy clustering, and the cosmic microwave background constrain the expansion history. The framework must predict a single history that fits these observations together, using the same exchange and gravitational laws that govern structure formation. [1] [3]

The cosmic microwave background is especially important because it records conditions long before the present generation of galaxies. A dark-matter supply that appears only after extensive star formation cannot simply inherit the early-universe successes of the standard model. Earlier hyperverse inflow or another initial component would need an explicit origin and evolution. [1]

Big Bang nucleosynthesis provides an earlier check. Changes in the expansion rate, gravity, or the radiation content can change the predicted abundances of light elements. Rapid expansion alone does not ensure that the proposed exchange is negligible; the relevant rates must be compared quantitatively.

Time-varying gravitational potentials also affect photons passing through cosmic structures, including through the integrated Sachs–Wolfe effect. A growing dark component and a varying G can influence those potentials differently. Their combined effect must be computed from the same underlying model.

Finally, precision observations constrain changes in gravitational strength. Lunar ranging tests drift in the local gravitational coupling. Cosmological observations constrain possible differences between earlier and present gravitational behavior, with results depending on the chosen theory. A mechanism that suppresses local variation while allowing cosmic variation must be specified rather than assumed. [8] [9]

3.4 Related theories and distinguishing predictions

This proposal has connections to several existing research directions. These connections help identify mathematical tools and observational tests; they do not establish equivalence between the models.

Braneworld exchange is the closest analogy to an external source. Harko and colleagues studied a reheating model in which dark matter enters a three-dimensional brane from a five-dimensional bulk. Kiritsis and colleagues studied cosmological evolution with energy exchange between brane and bulk. Their geometries and transfer laws are explicit assumptions that would need comparison with the hyperverse defined here. [5] [10]

Scalar–tensor theories provide examples in which effective gravitational strength changes with an evolving field. They illustrate why replacing a constant by G(t) is only part of the mathematical work: the field responsible for the change also has dynamics and gravitational consequences. [9]

MOND and emergent-gravity proposals address connections between visible matter and observed gravity through different mechanisms. Matching one of their galaxy-scale relationships would be a result to derive. It would not automatically establish consistency with lensing or cosmology. [7] [11] [12]

Particle searches also remain relevant. An external origin does not determine whether the incoming dark matter consists of particles or how it interacts with detectors. A failed search constrains the interaction model tested by that experiment; it does not, by itself, favor a hyperverse origin.

The distinguishing predictions should connect several measurements. Examples include a specified evolution of dark-matter abundance, a calculated relationship between transfer history and halo structure, a predicted sign and rate of change in G, and a corresponding expansion history.

A decisive test would use those relationships to predict new observations with parameters already fixed elsewhere. This is the standard the proposed framework must meet.

4 Conclusion

My central proposal is that our universe exchanges energy and matter with a larger hyperverse. Energy can leave the universe, dark matter can enter it, and the gravitational response may evolve with cosmic history. Gravitational persistence and a time-dependent G are proposed parts of that response.

The accounting equations show how an explicitly defined inflow can build a dark component while expansion changes its density. They also distinguish physical outward transfer from the redshift already present in standard radiation evolution. Those distinctions are necessary to keep the mathematics consistent.

The model is not yet closed. Its remaining physical ingredients are the hyperverse geometry, the interface and transfer laws, the dynamics of incoming matter, the persistence response, and the law governing G. These ingredients must jointly determine the cosmological correction terms and satisfy the conservation condition.

The next stage is to derive those ingredients and test the resulting predictions against galaxy rotation, lensing, cosmic expansion, the early universe, and precision gravitational measurements. The value of the framework will depend on whether the same mechanism explains these observations quantitatively.

References

[1] Planck Collaboration. Planck 2018 results. VI. Cosmological parameters. Astronomy & Astrophysics, 641, A6 (2020).

[2] Clowe, D., and colleagues. A Direct Empirical Proof of the Existence of Dark Matter. Astrophysical Journal Letters, 648, L109–L113 (2006).

[3] Riess, A. G., and colleagues. Observational Evidence from Supernovae for an Accelerating Universe and a Cosmological Constant. Astronomical Journal, 116, 1009–1038 (1998).

[4] Carroll, S. M. Lecture Notes on General Relativity (1997). See the gravitation and cosmology chapters for conservation laws and expansion equations.

[5] Kiritsis, E., and colleagues. Cosmological evolution with brane–bulk energy exchange. Journal of High Energy Physics, 02, 035 (2003).

[6] Bieri, L., Garfinkle, D., and Yau, S.-T. Gravitational Waves and Their Memory in General Relativity. arXiv:1505.05213.

[7] McGaugh, S. S., Lelli, F., and Schombert, J. M. Radial Acceleration Relation in Rotationally Supported Galaxies. Physical Review Letters, 117, 201101 (2016).

[8] Biskupek, L., Müller, J., and Torre, J.-M. Benefit of New High-Precision LLR Data for the Determination of Relativistic Parameters. Universe, 7, 34 (2021).

[9] Ballardini, M., Finelli, F., and Sapone, D. Cosmological constraints on the gravitational constant. Journal of Cosmology and Astroparticle Physics, 06, 004 (2022).

[10] Harko, T., Choi, W. F., Wong, K. C., and Cheng, K. S. Reheating the Universe in Braneworld Cosmological Models with bulk–brane energy transfer. Journal of Cosmology and Astroparticle Physics, 06, 002 (2008).

[11] Milgrom, M. A modification of the Newtonian dynamics as a possible alternative to the hidden mass hypothesis. Astrophysical Journal, 270, 365–370 (1983).

[12] Verlinde, E. Emergent Gravity and the Dark Universe. arXiv:1611.02269.