Entanglement Generated Forces and the Emergence of Spacetime

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Abstract

Relativity and entanglement are very different phenomenon in spite of occupying the same galaxy. We find that galactic rotation curves are an excellent measure of the validity of assumptions made about the *apparent* velocity of interaction of entanglement variables. There is, of course, no motion at all but it is convenient describe it as such for computational purposes. For instance, we find that an assumption of a nonlocal instantaneous kernel gives superb alignment with observed galactic rotation curves. The below work records the results between observation and theory for a number of rotation curves in terms of the disparity between theory and observation.

Keywords: Entanglement, Spacetime, Galactic duality, Galactic rotation curves, Dark matter, WIMPs.

Introduction

This paper introduces the idea of a separation of relativistic effects and entanglement effects in a galaxy. It's not just convenience. If you treat the two phenomena separately you get real results. Each phenomenon operates in its own domain. It's also not a question of nomenclature nor is it just semantics. It distinguishes between an ontological and an epistemological layer of reality.

Each of the separate domains is necessary for a complete description of the physics. It clarifies what is nonlocality; it separates causation from correlation; and it attempts to reconcile quantum theory with relativity. Entanglement exists in a nonlocal domain. Relativity has dynamics.

In all of this there is no signal transmission. Therefore, there is no contradiction with standard relativity. We compute galactic rotation curves, and the alignment between observed and calculated values is excellent.

Galaxies are easily delineated into either relativistic, spacetime S, or entangled, E. There is no velocity in E, interaction or otherwise. This is not a signal velocity nor is it superluminal. It does not carry information and it preserves Lorentz causality. The E domain does not have forces. However, force *can* arise as emergent.

There is no velocity in E, however we will propose one, infinity. It is purely a mathematical construct which reflects the real nature of interactions in E which are instantaneous. If

something takes no time to occur, we could claim it acts at infinite speed. It is a useful fiction to calculate galactic rotation curves.

We compare those calculations with observation. The resulting disparities between observed curves and the theoretically generated ones are remarkably small for undistorted galaxies, with ratios in the range of 2-4. Distorted galaxies have greater disparities, in the range of 45-110.

Definitions of the S and E Domains

We can assume that there is a duality of interactions in a galaxy [1, 2]. We identify S matter to follow Einstein relativity. S is used to denote spacetime. For example, no relativistic interaction can occur at speeds greater than c. The great majority of work done in galactic astrophysics follows Einstein's relativistic laws and operates in domain S. We could term typical galactic matter as relativistic matter since it is so closely and broadly correlated with relativity and defines a relativistic domain.

The other kind of galactic matter, which doesn't obey the rules of relativity, we will identify as entanglement matter E [3]. While the two share a galaxy, they don't share much else. Entanglement matter E operates in its own domain distinct from relativity. If you speed up E matter, its mass will not increase [4]. In reality you cannot speed it up. It will be not be moving in the E domain. There is no spacetime. The E domain is nonlocal, instantaneous, and does not have forces. Forces can arrive as emergent quantities from the E domain from patterns of entanglement. They interact with no time delay at all. They do not have position or trajectory. If all this sounds wild and strange, it is.

S is a space of source constraints. An easy way to visualize S is as a group of springs. They work just fine in their own domain. The interesting thing about E is that the typical qualities of space can emerge from E. There are no paths, but the space that emerges from E can have paths.

Some of what is going on here can mimic dark matter. Spacetime in S explains gravity as curvature. A nonlocal kernel is a mathematical function that defines how a point in space interacts with other points over a distance. It depends on values at all other points. It doesn't just depend on derivatives but also integrals because it integrates over a region. They are important in modeling interactions across a distance. Quantum interaction does not involve any physical interaction traveling at infinite speed. They show instantaneous correlations which cannot transmit information. This is Einstein's spooky action at a distance. It is actually nonlocal correlation. Nonlocal kernels describe how space is interconnected. The system's mathematics show the effect of values at distant points with no time delay. In summation, we get instantaneous mathematical coupling. Whatever is going on, there is no transmitted signal, no energy moves, or no causal influence. Nothing actually propagates. Mathematically this is equivalent to infinite speed but nothing is actually moving.

Calculation of Galactic Rotation Curves

If everything is moving at the same speed, there is no time lag. There is no spacetime in E, therefore no lag. We get a single global entity. That is one enormous advantage of the postulate. It gives astonishingly precise alignment with observations of galactic rotation curves. The table below shows the results when observed data [5] are compared with computational results [6].

1. TABLE OF DISPARITY RESULTS FOR VARIOUS GALAXY TYPES

Galaxy	**Distortion Type**	**Disparity**
NGC 3198	None	2
M 33	None	3
NGC 2403	None	2
NGC 5055	None	3
NGC 6946	None	4
M 82	Starburst	60
NGC 2443	Warped spiral	60
NGC 3014	Irregular	55
NGC 1614	Major remanent	70
ARP 148	Collisional ring	80
Antennae	Tidal tails	110
NGC 2903	None	4
NGC 3621	None	2
NGC 1097	Barred spiral	45
NGC 1313	Irregular	50
NGC 2146	Starburst	65
NGC 3256	Merger remanent	75
NGC 4654	Tidal	70

We choose to report the galactic result as disparities because the results are more pictorial and are easiest to digest.

As the table illustrates, the low disparities, 2-4, work well in alignment with the observational rotation curves. The model works because the E domain is a nonlocal instantaneous constraint which modifies the effective gravitational potential. The higher disparities come from galaxies which are themselves inherently distorted [7].

Why does our rotation curve model give such good results? Because it is nonlocal by construction. Instantaneous global coupling gives the correct effective potential. In effect, we are going from a differential equation to an integral equation.

Theories of Missing Gravity

Does the universe really select which path to take or is it like water running downhill, where the water takes the path that requires the least energy?

When people started looking at these galaxies, they found there wasn't enough visible mass to keep the galaxies stable, so physicists waved their magic wands and conjured up the missing mass out of the pliant emptiness. Yes, they thought, the required mass is there but you just can't see it. We'll call it dark matter. They even invented particles to supply the missing mass: Weakly Interacting Massive Particles (WIMPS). As it turns out, missing mass was not the problem at all with galactic rotation. It was missing force.

Thus, there has been a long and frustrating search for those huge, but barely discernable WIMPy ghosts, but none were ever found. However, the search went on. It's still going on.

If you keep looking for something for fifty years, there is a good chance it doesn't exist. So why don't the galaxies disappear into the mists of infinite space? Perhaps because you are searching for the wrong thing. The existence of a measurable rotation curve implies something happens between the two objects even if no signal or force is transmitted.

Questions About Dark Matter and WIMPs

Does the E-S domain model explain the many anomalies in galaxies? No. Then what good is it? The answer is that it elevates the role of entanglement. It shows that spacetime could emerge from entanglement, not the other way around. It suggests that entanglement could be more fundamental and probably more important than spacetime.

We must also deal with dark matter that nature apparently has thrown into the pot. It serves a multiplicity of roles. In the beginning of their quest, scientists invented a type of dark matter called WIMPS. They were assumed to be the massive particles supplying enough gravity to hold a galaxy together that nobody could ever find, but that some people still believe exist. This was matter that was conjectured to exist, but does it?

We know there isn't enough observable mass to hold a galaxy together. Scientists spent 50 years in a fruitless search for this matter, but to no avail. Why? Because it was not matter that was missing. It was force, gravitational force.

Now presuming something existed, which for 50 years scientists looked for but never could find, the search was and is an exercise in futility. In all these years other ideas came to the fore such as emergent gravity which didn't need a massive object to create it. But dark matter still appears to be a tenable explanation.

We will now formulize the idea that the foundation of the universe has two domains, separate and distinct. The relativistic domain uses general relativity S (spacetime) to express itself. It has been enormously successful. The entanglement domain, E, has received less exposure, but it actually appears to be more fundamental than spacetime.

What have we surmised? The universe has two pathways to achieve its goal of possible minimal expenditure of energy or possible maximal beauty or maybe even something else. We need Einstein's relativity for a rational universe, but we also need entanglement. The new entanglement ideas do not diminish or extinguish relativity — they augment it.

Explanations for Missing Gravitational Force

Into this mix let us propose some core axioms. Spacetime is emergent.

The universe expands. But it isn't necessarily visible particles with massive gravitational force that keep the universe stable. In other words, we don't necessarily need dark matter all the time, but presently it certainly is the chief culprit.

Distant galaxies show large-scale correlated polarizations revealing large quantum coherence.

The infinite speed fiction of entanglement gives the superbly precise galactic rotation curves with the remarkably small disparity between observation and experiment. But the reason that the rotation curves must interact at all is so there is no lag. Everything is instantaneous, and there is no place for any hesitations.

The initial postulate is that entanglement results in the observed the rotation curves. So, our repugnance for WIMPs reveals itself because there can be no lag in the quantum description of motion. Everything is immediate. Voila, it all hangs together!

Do galaxies move coherently? Yes, they do because the gravitational response at any point depends on the entire mass distribution simultaneously.

The Bullet Cluster

Now let us touch on one of the great galactic anomalies, the Bullet Cluster. The S domain matter obeys relativity and E matter obeys entanglement. The S domain is not a field that moves at infinite speed, but it is responsible for cohesion and gravitational scaffolding. What causes light to bend in the Bullet Cluster [8]?

The Bullet system is complicated by the gas moving in one direction and the matter moving in another direction. Galaxies in clusters exhibit phase alignment not gravity alignment. Galaxies move as coherent objects.

Consider entanglement density across galaxies, clusters and cosmology. Galactic rotation curves predict declining velocities at large radii. Baryons by themselves predict declining velocities at large radii. Velocity curves flatten during observed galaxy rotations without postulating exotic particles.

In Clusters, like the Bullet Cluster, gas is collisional and lags behind in mergers. Galaxies are collision-less and move ahead. Entanglement tracks galaxies, not gas, so lensing peaks align with galaxies and are offset from X ray gas, matching Bullet cluster behavior [9].

Cosmology and Cosmic Microwave Background (CMB) treat entanglement as pressure-less dust in Friedmann equations. It deepens gravitational wells, sets correct acoustic peak values in the CMB, and boosts growth. No exotic dark matter is needed. Entanglement acts as a collision-less, pressure-less-stress energy component that scales with baryons at galaxy scale. It localizes galaxies in clusters. It is quite simple. One rule, three scales, one effect.

Can our E-S duality model provide help anyplace else? Yes, lensing gives a picture of the curvature of space. If that curvature is produced by E, S and duality, we surprisingly have the variables which we can use to investigate curvature. Is E responsible for coherence and scattering? Yes, on the first, no on the second.

Characteristics of the S and E Domains

E behaves like a global constraint but it is not a force or field. All degrees of freedom in S have corresponding source variables in E. E enforces consistency conditions across the entire universe at once. S is the emergent geometric projection of those global constraints.

E is not a field or a wave function. It is a timeless algebraic space of constraints. E updates instantaneously so every mass in the universe contributes to the constraint structure of every other mass. That implies inertia is global. Local dynamics depend on total mass distribution. Rotation curves will flatten without dark matter.

In S, this results in a relativistic force law. Although they are very different, E and S can communicate requiring no time which implies nonlocal causation without paradox. E can coordinate entangled states; E can enforce global conservation; and E can cause “spooky” correlations in S. Hello Albert.

However, E is outside spacetime, so there is no paradox. This results in quantum entanglement, Bell correlations, instantaneous collapse, and global conservation constraints. Since E is the domain of sources, forces are emergent projections. Curvature in S is the geometric expression of E.

Gauge fields in S could be bookkeeping for E constraints. This therefore unifies geometry (gravity), gauge symmetry (electromagnetism), and quantum entanglement (nonlocal constraint). The E domain is paramount.

E is the engine. S has locality and geometry. E has none of this, but it determines everything. E is the real ontology. S is emergent.

Further characteristics of the S and E domains are explored in the Appendix.

Facets of the Domains

In E, everything is adjacent to everything else. There is no distance, no metric, no locality. All degrees of freedom are accessible. Constraints can be solved globally rather than locally. There is no lag between any two points.

How can there be an apparent infinite-speed interaction which, of course, does not exist? It is a constraint structure instead of dynamics. E does not evolve in time. It resolves like a timeless algebraic space of consistency conditions. E enforces global coherence across S. It is a domain where laws are relations, not differential equations. Every physical quantity in S has a source variable in E. Mass in S is an inertia source in E. Charge in S is a gauge source in E. Spin is a symmetry source in E.

For any change in S, E updates the entire constraint network. Entanglement correlations are without signals, nonlocal global conservation laws, or gravity emerging from universal coupling.

E has no metric but it does have structure. S is a projection of E. Therefore, spacetime emerges from constraints. Forces emerge form E coupling. E has no time. Local acceleration depends on entire mass. Galactic rotation curves flatten. Entanglement is defined in Hilbert space, not spacetime.

Relativity is a complete classical theory without quantum input. Causal structure exists even in vacuum spacetimes.

Lorentz invariance is not derivable from entanglement alone. Curvature arises from *compatibility constraints* between the two. Curvature is a mismatch between E distance and S distance. Lensing is the optical consequence of E-S compatibility. Black holes are regions where E-structure and S-structure diverge maximally.

Conclusion

The premise in this paper is that relativity and entanglement are so different that they should be treated as separate entities. They each have their own specialized domains in which they operate.

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Appendix

We argue that entanglement structure (E) and relativistic geometric structure (S) possess independent ontological status and should not be identified with one another, even in emergent-spacetime frameworks.

While contemporary approaches—such as ER=EPR, holographic duality, and tensor-network reconstructions—tend to conflate entanglement with geometry, we propose that E and S are distinct but interacting layers of physical description. Entanglement defines a correlation topology in Hilbert space, whereas relativity defines a causal-metric structure in spacetime.

Curvature arises not from either layer alone but from the compatibility conditions imposed when E and S are jointly realized. One can develop a model illustrating how curvature emerges from mismatches between entanglement-defined adjacency and relativity-defined causal distance. This two-layer ontology avoids conceptual circularity in emergent-gravity programs, clarifies the role of duality constraints, and provides a new interpretational framework for gravitational phenomena such as lensing.

The separation of E and S offers a more flexible foundation for quantum gravity, one in which geometry is neither fundamental nor reducible to entanglement, but instead arises from their structured interaction. The separation of E and S is crucial in this. Geometry comes from the structured interaction of E and S. E and S have different ontological requirements and should not be mixed as similar even in emergent spacetime.

Typical approaches conflate entanglement with geometry. In our approach, E and S are distinct although they can interact. Entanglement is the correlation topology in Hilbert space while relativity is the causal metric structure in spacetime. Curvature comes from both layers together through compatibility imposed on both E and S together. Curvature emerges from mismatches between entanglement adjacency and relativity defined causal distance.

The two-layer ontology is irreplaceable in emergent gravity definitions. It clarifies the role of duality constraints and identifies a different view of gravitational lensing. We reiterate that E and S are independent. Curvature is an interaction effect. Curvature is a mismatch between E distance and S distance. Lensing is the optical result of E-S compatibility. What is the E-S dual layer framework? E is correlation topology. S is causal metric structure. Black holes are regions of maximal divergence structure.

The next question is what happens at the boundary between E and S. Is there a sharp change between the two as though there is a wall between the two? No, there is a smooth transition between them which implies that the transition region between them has both E and S in it until one of them exhibits predominance.

What is new in all this? E and S are separate and distinct although they may come from the same galaxy. They do not conflate. Separating E and S clarifies spacetime and gives a new way of interpreting curvature. We get two layers, E and S. Curvature is a mismatch between E distance and S distance. The boundary between the two domains is not a wall but a region where entanglement and spacetime meet and mix before separating into their respective domains.