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Modified Spacetime Geometry Addresses Dark Energy, Penrose's Entropy Dilemma, Baryon Asymmetry, Inflation and Matter Anisotropy

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Abstract

A model of modified space time is discussed. Implications for causality regarding modern anomalies and paradoxes are made. Topics addressed include a dark energy candidate without introduced gravitational screening. The dynamics of the repulsive force of quantum geometry allow the validity of the second law continuously through a universe's death and rebirth. The baryon asymmetry is explained without addressing the Sakharov conditions. Inflation and anisotropies in an FLRW universe are also attributed to quantum bounce phenomena. No attempt at quantification is made.

"The temporal order of events [sic] is irrelevant."
-Richard Feynman

I. Dark Energy

Consider the spacetime diagram in a region surrounding the big bang, where $ct = 0$ corresponds to the apex of a quantum geometric "bounce" rather than a divergent singularity. At $ct = 0$, allow the superposition bounce state to decay into two time arrow eigenstates. By convention we say our universe is the eigenstate moving forward in time along the positive *ct* axis. The other decay product is another universe experiencing forward flowing time in the direction of our negative *ct* axis.

To allow dynamical interaction between the universes to take place via a familiar mechanism wrap the *ct* axis around a cylinder. The big bang occurs at $\varphi = 0$ and the big crunch for each universe occurs at $\varphi = \pi$. The inertial frame 3-spaces of each universe are manifolds propagating in opposite directions around the *ct* circle. If we allow gravitational interaction between 3-spaces to occur along the *ct* axis through the point $\varphi = \pi$, the gravitational potential energy between the universes could alleviate the need to discover gravitationally repulsive "dark energy." Interaction through the point $\varphi = \pi$ is plausible since we are not considering any kind of conformal infinity that would be required if our bangs and crunches were singular. Instead we are dealing with quantum geometric "tunneling" where everything remains pleasantly continuous. The gravitational interaction acts along a single axis so anisotropies in one universe's matter density do not appear as gradients in "force" on the other universe. This is in good agreement with the uniform action of the controversial cosmological constant.

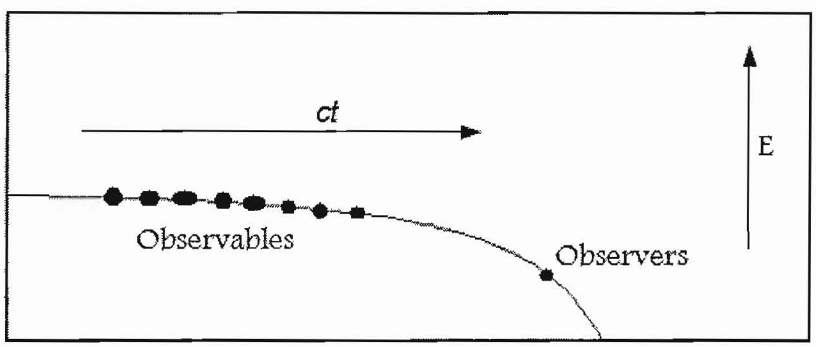

Figure 1

Given an assumption of interaction through the big crunch, forward in time points "downhill" toward a lower energy state. (Fig. 1) Observations have been made supporting this. Since we are further along in time than the astrophysical objects we observe, we can think of ourselves as deeper into a gravitational well than these megaparsecs distant objects. If this were so, we would be accelerating away from the observed object images. This is an alternative interpretation of data suggesting that the more distant an object lies, the more quickly it accelerates away from us. Acceleration is relative and in the paradigm presented here it is more intuitive to conclude that this data shows us to be accelerating away from the past, toward the future.

II. Entropy Considerations and Baryon Asymmetry

The only thing relevant to the quantification of entropy is a system's macrostate as defined by a set of parameters. Before examining the entropy of the present two universe system, consider the following topological manipulations. (Fig. 2) The big bang and crunch are identical and may be mapped into each other by twisting the *ct* circle into a figure eight. Twist it once further so that time forms a circle once again but now forward time for each universe is in the clockwise direction. Finally, center the dynamics on the bounce state so the death and rebirth of each universe is schematically clear.

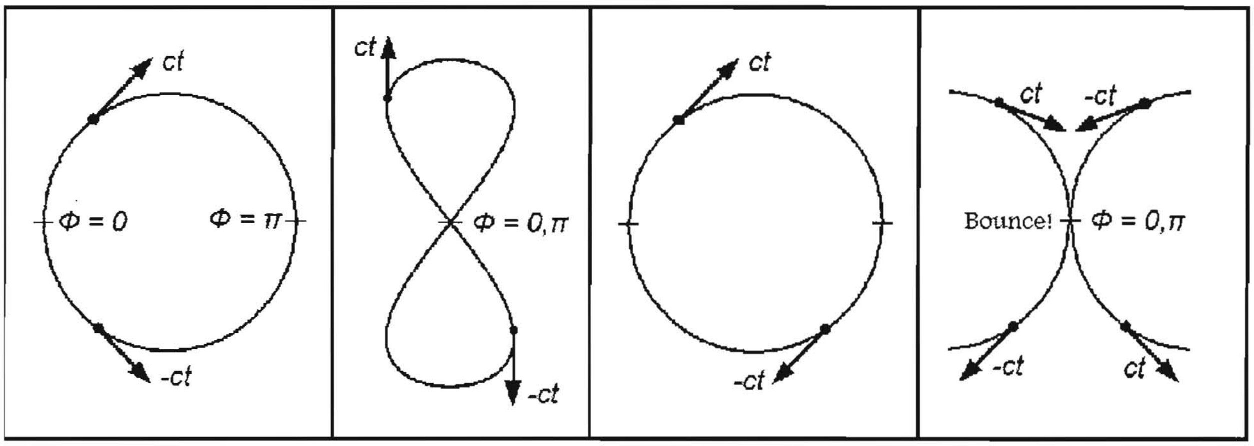

Figure 2

In the final frame of Figure 2, the semicircle on the left represents our perception of the larger system just before the big crunch. Our universe is nearing a state of maximum entropy and the reverse time universe is converging on its minimum entropy big bang. After the bounce we again find one universe at a maximum of entropy and another at a minimum. As there is no way to tell which is the forward or reverse time universe, this interaction is analogous to the rearrangement of identical particles – a process long known to be isentropic. To alleviate problems with human intuition in perceiving the flow of time, let us replace the spacetime diagram with the familiar Feynman diagram where a rigorous framework is already in place for dealing with interacting parties moving in different directions through time. (Fig. 3) If we give ourselves fully over to the Feynman diagram, we should consider the reverse time universe to be the "antiparticle" of our universe. Then it has a negative baryon number and the greater system at hand becomes baryon neutral in good agreement with predictions.

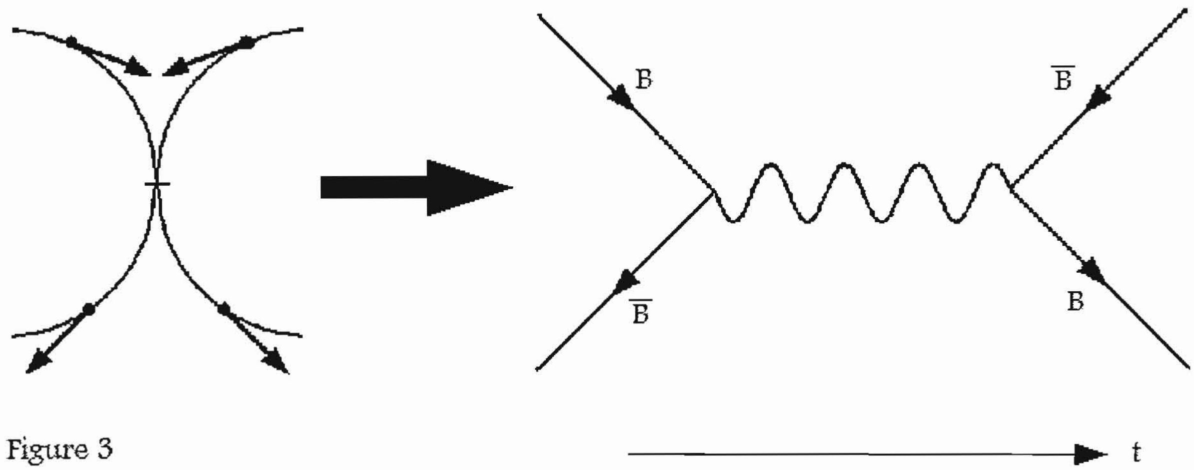

Figure 3

III. Inflation and Galactic Seeds

Again, consider the moment just before the two universes reach $\varphi = \pi$, when the volume of physical space is much less than one cubic meter. The gravitational "field lines" then extend much less than one meter along the *ct* axis between *3*-spaces. Then the big crunch occurs with the transition of two distinct universe wave functions into the unified bounce state. In this maximum density state the field lines are very short and dense but are overcome by the repulsive force of quantum geometry. Very shortly thereafter the field lines span the entire *ct* circle again, corresponding to a distance of two complete universe lifetimes.

Consider the period of time starting when the field lines are maximally short and ending before they become very long again. These "field lines" represent an energy density that must deform spacetime. As the bounce rarefies these field lines so that they once again span two universe lifetimes it is possible that the bifurcating *3*-spaces are dragged along with them in a manner similar to the warping of spacetime around a rotating black hole. The utter suddenness of the transition between quantum states is in good agreement with the 10^{-35} to 10^{-32} second time window in which inflation is hypothesized. Additionally, any argument against inflation based on superluminal matter velocities can be sidestepped as the arrow of time is not well defined until after the decay of the bounce state is complete.

Assume that our differentially nascent, minimum entropy universe can be perfectly described by an FLRW model of uniform dust. Just as the time arrow is not well defined during the bounce decay, neither are the other spacetime axes. Then during the decay of the bounce state – called the period of inflation – the turbulent matter distribution of the maximum entropy universe will exert non-uniform action in the minimum entropy system before two distinct *3*-spaces emerge. This brief action is sufficient to sow the seeds of the first galaxies in a mathematically perfect Freidmann fireball or catalyze gravitational clumping in a more realistic fireball.

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