Time Complementarity in the Inflaton Spacetime Model

Richard P. Dolan

Abstract

In the inflaton spacetime model, there is an inherent duality between the block universe view of time and our view of time that flows. These views are complementary in the same sense as the wave and particle views of the photon. While the laws of physics see the block universe, we only see time that flows because we are made of the flow of time.

We've been learning some things about spacetime—that it is neither nothing nor empty, that it may be discrete in some way. The inflaton spacetime model[1] is concerned with its composition, structure, and dynamics. The model supports the standard models of particle physics and cosmology and makes it easy to see why these models work so well. It has a lot to say about time, and that is the subject of this essay.

In the inflaton spacetime model, spacetime is made up of discrete quantum objects. For lack of a better word, these are called *points*. Only points exist, nothing else. Points are *self-reproducing*—every unique nonempty set of points creates another point. The universe begins with a few points—as few as two. Let's say there are two points. This set has three nonempty subsets, and so there are three points. Now there are seven nonempty subsets, so seven points, and so on. Spacetime consists of a succession of logical levels of increasing cardinality. If there are N points at one level, there are 2^N-1 at the next level: N points that are images of the original N, plus a lot of new ones. The number of points rapidly becomes astronomical. This is a purely logical progression. Time has nothing to do with it.

The idea of self-reproducing points may seem a bit strange, and one may well ask if there is any justification for it, or if it is simply postulated out of thin air. In fact there is justification for it, although it is beyond the scope of this essay and of the inflaton spacetime model itself. Interested readers can find it here.

So, how many points are there? This is Cantor's paradox. The set of all sets, or the universe, appears to have all cardinalities at once. It is a paradox of self-reference, that is, of the recursive way in which points are created. Such paradoxes can often be resolved by introducing the notion of time. If each logical level is later in time than the preceding one, we have a set of points that expands in time. In the model, this is the big bang at the beginning of the universe. The extremely rapid expansion does not continue indefinitely, but only until a phase transition that we won't be concerned with in this essay, after which the expansion continues but much more slowly.

As quantum objects, points are completely described by their quantum numbers. Their three main quantum numbers are called, by convention, *position*, *spin*, and *time*. All of these are *intrinsic quantum numbers*. The name "position" doesn't imply that points exist in some space. Only points exist. Given any two points with different position quantum numbers, there is no requirement that there be another point with an intermediate position quantum number. "Between" points is nothing—the void. Similarly, time has meaning only at discrete steps of a point's time quantum number—there is no intermediate time. Thus, space and time are illusions—they don't really exist. This essay is about how we are able to see them at all.

Notice that in the inflaton spacetime model, time has two aspects, that is, there are two ways to look at time. Either the expansion is purely logical and there is no time, or time flows as the universe expands. The first view, often called the block universe, is the only view that is compatible with special relativity. The second view, time that flows, is our view. It is the only way we see time. Which view is correct? There has been much

discussion on this point in the physics literature, but in the inflaton spacetime model, this duality is inherent. Like wave-particle duality, the correct view depends on how time is observed. The two views are complementary, like the wave and particle views of the photon. We only see flowing time, but the laws of physics see the other view. Why can't we see the block universe?

The answer is that we are made of particles, and particles are made of the flow of time. In other words, we can only see time flowing because our existence depends on the flow of time. To understand this, it's necessary to know what particles are, and to get there, we have to start with points. I'll only hit the highlights, since the details are available elsewhere.[1]

Points are either fermionic or bosonic. Interaction between the two types leads to gravity, which draws together their position quantum numbers. No two fermionic points can have the same position quantum numbers (the exclusion principle), so eventually they settle into a lattice, where degeneracy pressure maintains a Planck-scale average distance between them. Their positions are not fixed, but exhibit quantum fluctuations. Recall that at each level of the expansion, there appear images of the preceding level's N points, plus new points. In the flowing time view, the position of each point varies randomly from level to level, or to use time words, from time tick to time tick. The variation is constrained by degeneracy pressure to lie within a Planck-scale cell bounded by other fermionic points. Thus, each fermionic point looks like a particle in a box, the random fluctuations in its position representing energy. Every point has a minimum, ground-state energy, and some have energies above the ground state. Point energy is quantized, and energies above the ground state represent fermionic particles.

What this means is that at a single time tick, you don't see particles, only points. To see particles, the points must be observed at a succession of time ticks. It takes the flow of time to make a particle, so it takes the flow of time to make a human, and that is why humans only see time that flows.

To close this essay, I'd like to comment on an argument that has been proposed[2,3] in an effort to resolve the apparent conflict between the laws of physics and our view of time. It suggests that time consists of a series of instants, or "nows," each of which is like a photograph, showing all particles, all human beings, all brains, all memories, and so on. The argument suggests that you can mix these up, and we wouldn't notice any difference, since at any instant, our memories would all be correct for that instant, and if you put all of these photographs in a pile, it would be fairly easy to put them back in time order. Therefore, time doesn't really flow at all; it just seems that way. The flaw in this argument is that, as we have seen, if you look at spacetime at any instant, you don't see particles, people, memories, and so on, but just a collection of points that, except for random fluctuations, looks the same from instant to instant. Time that flows may be an illusion according to the laws of physics, but it is necessary and therefore real to us.

References

1. Richard P. Dolan, “Inflaton Space-Time: A Discrete Quantum Space-Time Model Underlying the Standard Models of Particle Physics and Cosmology,” *Physics Essays*, Vol. 19, No. 3, September 2006 (published July 2008), pp.370-405.

2. Brian Greene, *The Fabric of the Cosmos*, Alfred A. Knopf, New York, 2004.

3. Julian Barbour, *The End of Time*, Oxford University Press, 2000.