A Brief Note on the Asymmetry of Time

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Abstract

Given a granular space-time where the grains can move freely in x, y, z, and also t. But there is a very small, symmetry-breaking increased probability of a grain moving forward versus moving backward in time. At this juncture then, there is no discernible arrow of time. In order that masses not be pulled apart by moving grains, we assume that grains clump together when the grains hold mass. The more mass there is, the more grains are in the clump. We show that as the clump grows larger, the more the probability increases of the clump moving forward in time as opposed to moving backward. So when the clump size grows to measurable dimensions, the arrow of time points consistently forward.

Background

An earlier paper[F1] postulated a stochastic space-time. A later paper[F2] introduced granularity to space-time, whilst a third paper[F3] explored the nature of time. This paper extracts the key (and most important) result of that third paper, i.e. an explanation of the asymmetry of time in light of space-time's granularity.

The nature of time is contentious: Hawking[H1], Fujii[F4], (as well as myself[F3] and others) believes that time is a complex dimension. Julian Barbour[B1] however, believes that time doesn't even exist. Lee Smolin[S1] and Carlo Rovelli[R1] believe that as well but in the context of Loop Quantum Gravity.

The arrow of time is contentious as well: Maxwell's Equations for electromagnetic transmission say that there are two solutions for every transmission; a 'retarded' solution, i.e. where radiation travels forward in time, and an an 'advanced' solution where the radiation propagates backwards in time[D1]. The advanced solution is usually dropped, but there seems no physical/mathematical reason for doing so. On the other hand, Boltzmann's theory of entropy[D1] links the omnipresent increase of entropy with the forward-pointing arrow of time.

The model in this paper, while exhibiting an increase of entropy, explains the forward arrow in a different way.

The Growing Asymmetry of Time

We assume that grains migrate stochastically in x,y,z,and t. And the probabilities of migrating in one direction is the same as in the opposite direction. And this applies to t as well as to x, y and z. So at this juncture there is no arrow of time. But now consider a very small (ε) increase of symmetry- breaking for t, so that the probability of a venue going forward in time is 50+ε percent and 50-ε percent probability of going backward in time. This is so close to equal probabilities as to be effectively equal probabilities (.5+ε and .5-ε).

We propose that so masses not get torn apart by the motion of grains, grains clump together when the grains hold mass.

Two grains clumped together have forward and backward time probabilities of (.5+ε)*(.5+ε) and (.5-ε)*(.5-ε) respectively. So the ratio of forward to back is larger than the single case.

(This is easy to see as the single grain ratio can be written as $\frac{(.5-\varepsilon)*(.5+\varepsilon)}{(.5-\varepsilon)*(.5-\varepsilon)}$ and the two grain case as $\frac{(.5+\varepsilon)*(.5+\varepsilon)}{(.5-\varepsilon)*(.5-\varepsilon)}$.) This ratio can become quite large for particles covering a large number of grains. For example, the diameter of a proton is estimated[Z1] as about .833*10^{-15}meters. So its approximate volume is $\frac{4}{3}\pi(.416*10^{-15})^3$ meters^3. Assuming that the volume of a grain is one Planck length cubed, (1.62*10^{-35})^{3}meters^3, that corresponds to about 7x10^{58} grains.

Mass then, determines the arrow of time. And each mass has its own arrow.

A neutrino though, is exceedingly small. It may possibly cover so few grains that its going backward in time probability is non-negligible.

There is a problem: When do the migrations occur? *When*ness is something of an amorphous concept when time itself is migrating. A two-component time (see below) could provide a solution.

Avoiding the Time Paradox

'Time' can be considered to have two characteristics: a coordinate (τ) from minus to plus infinity (or from the big bang to some end of time), and a sequencer (υ), an ordering schema as described by H. Reichenbach[R2]. determining the direction and 'speed' of time.

So for migrations in time as well as space, we need two kinds of time: coordinate time (as in x,y,z, and t), and sequential time (a measure of something coming before or after something else, and the interval between them). The sequencer then, defines the *when*ness.

And another problem/paradox: At any given laboratory-time t, the same grain will (simultaneously) be at a very large number of x coordinates. If there were mass/energy at the venue, this would be very problematic as causality and conservation of mass would be violated.

We'd like to treat the time dimension, t, in the same way as we treat spacial dimensions. But there is a big difference between a space and time coordinate: Consider the graphic below:

A particle (the black disk) starts at x=0, then moves to x=1, then 2, then 3. (We are considering space-time to be granular, hence the coordinate boxes.) There is a single instance of the particle.

But time is different:

A particle at rest is at t=0, then moves to t=1, etc. But when it goes from t=0 to t=1, it also remains at t=0. There are now two instances of the particle, etc. In other words, a particle at a particular time is still there as time advances, and the particle is at the advanced time as well.

We define then, a new quantity, τ (tau-time), that acts much like the usual time, but in accord with the first graphic, above, i.e. when the particle advances in time, it erases the previous instance. That is to say, 'τ-Time Leaves No Tracks'. And that resolves the paradox.

Acknowledgments

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