An Insight Into Information, Entanglement and Time

Time One: The Subtime Conjecture

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Classical Time

T_c

$\mathbb{R}^n$ **Flawed Assumption**

Universal, Smooth, Infinite, Monotonic, Irreversible

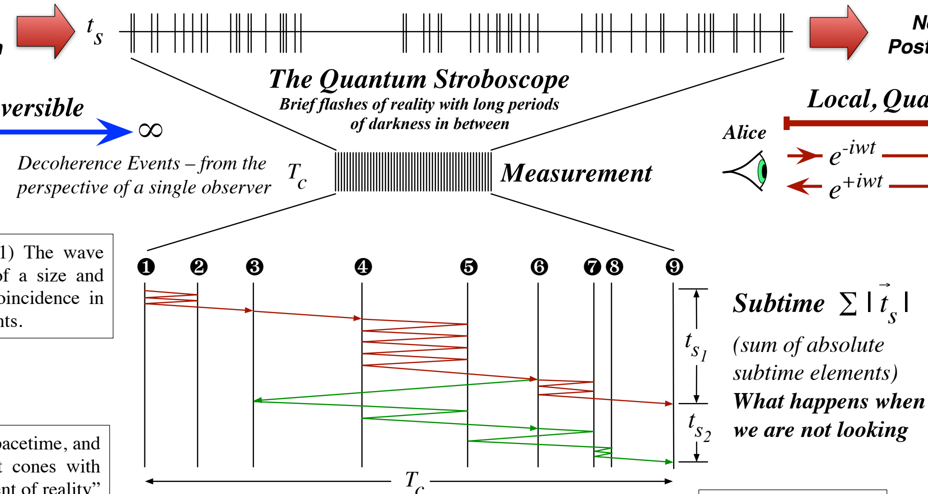
∞ → ∞

Subtime

t_s

New Postulate

Local, Quantized, Finite (Bounded), Reversible



Triangle Identity
$|a+b| \leq |a| + |b|$

Classical Time $|\sum \vec{t}_s|$

(absolute value of the sum of subtime elements)

What we, our instruments and computers observe

Paradox

There are two often conflated paradoxes in Quantum Theory: (1) The wave behavior of energy quanta when passed through multiple slits of a size and separation comparable to its wavelength. (2) The unexplained coincidence in correlated events in the time averaged record of Bell state experiments.

Minkowski Spacetime

We challenge the assumption of a background of 4D Minkowski spacetime, and replace its implicitly smooth, infinite and global notion of light cones with *subtime* (t_s): a local, bounded (quantized), and reversible 1D "element of reality" to account for increments and decrements of photon information. In t_s, photon information transfer is negative with respect to the transmitter and positive with respect to the receiver. Information and energy are conserved in the entangled systems that we measure in *classical time* (T_c). Minkowski space misleads us that time passes independently of the spatial dimensions.

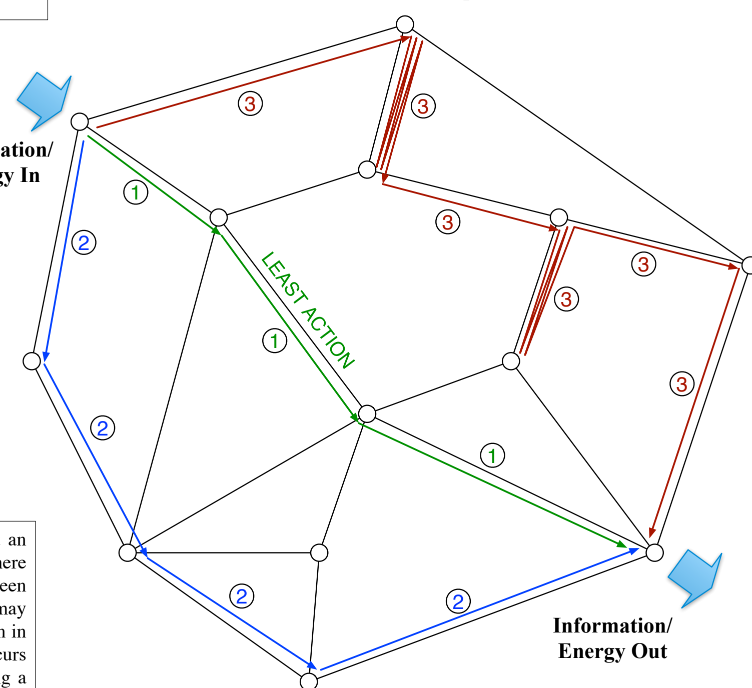
Multiple Slit Experiment

We address wave behavior with solutions to Maxwell's equations (Poynting's twist waves) which yields helical photon traversals along the one-dimensional paths bounded by emitters and absorbers. Wave behavior manifests as helicity eigenvalues marking off wavelengths. Their phases align with those atoms whose reflectivity and absorption matches in the detection plane normal to the experiment, with an intensity proportional to the square of the amplitude at any random (or chosen) orientation.

We question the assumption that photons pass once only through both slits *"at the same time."* Instead, photons pass back and forth an uncountable number in subtime (t_s). They appear to traverse once only in T_c because of our inability to measure subtime recurrences.

Bell State Measurements

We address unexplained coincidences in Bell state measurements against an assumed backdrop of T_c by postulating an "element of physical reality" where *entanglement* may be described as a "hot potato" photon trapped between alternately reflecting atoms. This reversal of time, energy and information may recur an uncountable number of times in t_s, and yet be unobservable (frozen in T_c). Symmetry is broken when an external interaction is prepared, or occurs randomly. This triggers the flow of energy and information – establishing a new seed (root) for a casual and thermodynamic direction.



Conjecture

Subtime (t_s) is *inextricably intertwined* with *space* along the local, one-dimensional path bounded by *photon traversals* between *emitter* and *absorber* atoms. Subtime is reversed in all ontological respects as the photon is returned to the previous atom. Two atoms exchanging a hot potato photon with each other *in perpetuity* comprise a bipartite entangled pair. Entanglement in t_s will appear "frozen" in T_c.

Description

Nature is not only symmetric in subtime at the atomic level, but is capable of reversing itself *in perpetuity*. This accounts for our failure to explain entanglement based on an immutable causal logic. When time (change) happens, we remember; if it happens and then the change is reversed, we don't. Even events that have already decohered in T_c which we might think to be immutable once they have *happened* can (at least locally) *unhappen*. We should expect to see remnants of these reversed "elements of physical reality" as a natural aspect of the (apparently) persistent record we call history. Destructive interference is a state of *darkness*. The photons are indeed there, they are simply bouncing back and forth in subtime, invisible to us and our instruments.

Implications

- Photons are the carrier of time; the Universe is a network automaton.
- Subtime provides insight into quantum theory's paradoxical nature and appears to be logically consistent with results of Bell experiments.
- Entangled systems are dark, i.e., outside of classical time. Entangled systems are unavailable either as emitters or absorbers. Subtime recurrences and their trapped energy/information are unobservable in T_c.
- The massive unrealized concurrency under the hood of entangled information/subtime is reminiscent of the hoped for parallel computation capacity of quantum computing. We question whether massive concurrency exists in quantum computation, and suggest instead that we have been sampling subtime like a stroboscope in T_c: brief flashes of reality with long periods of darkness in between.
- Experiments can readily be conceived to falsify this conjecture.

Essay: http://fqxi.org/data/forum-attachments/Borrill-TimeOne-V1.1b.pdf