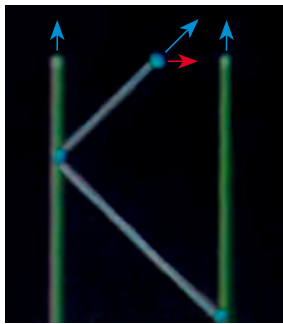
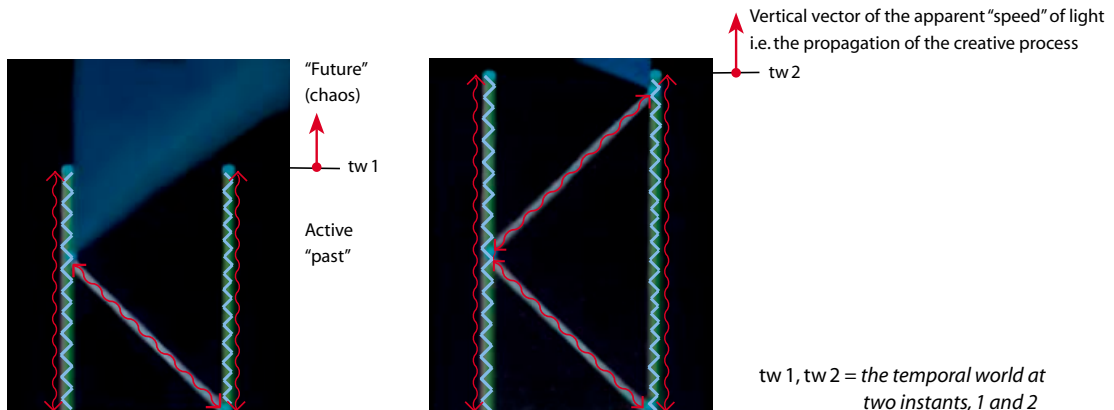


## A visual model of "billiard balls" and spacetime vs. a visualized reality (?) of waves and creative processes



← The last record of a continuous series of instants of an imaginary world of particles.

An animation made of instants like this, and a few other animations, by Rob Salgado (<http://physics.syr.edu/courses/modules/LIGHTCONE/LightClock/default.html>), intended as a pedagogical aid to the understanding of special relativity, has inspired to the appearance of these diagrams. They are very suitable for its purpose, but the rendering of photons as billiard balls may be misleading when trying to understand quantum mechanics. However, the method of "tracing out" spacetime diagrams using an imaginary "light clock" may be helpful, also when trying to get a critical understanding of a "process interpretation of the [Transactional Interpretation of Quantum Mechanics](#)".



Compared to the evident differences between the upper diagram and the diagrams below, the difference as to how they should be *interpreted* is even more important.

**The upper diagram** shows how the "worldlines" of a spacetime *diagram* are being "traced out" by the atoms of two mirrors – (the top of) the vertical lines – and a reflected photon (the blue ball) of an *imaginary light clock*. The "real ('temporal') world" seems here to be regarded as made of some kind of very small hard spheres. Actually – because an absolute present isn't found – the reality is often regarded as better represented by the *diagram* itself (i.e. a block of world lines without a flowing time) than by descriptions which consider the present as the ultimate reality. – But, in fact, the upper diagram shows an *imaginary process* regarded by a *real observer* (you and I) at rest relative to the objects that trace out the vertical lines, whereas **the lower diagrams** shows (or at least are supposed to show) the "tracing out" – or creation – of a (hypothetically) *real process* (not just a diagram), as seen by an *imaginary observer*.

As a result of complicated processes – *in principle* resembling the process which is about to be explained – the atoms of the two mirrors repeatedly (at an internally generated speed) reproduce themselves (i.e. their creative processes), forming a growing structure of "rays", which is symbolized (above) by the blue zigzag lines and their green background. (cf. the "zigzag picture of the electron" and other fermions in Roger Penrose: *The Road to Reality*. Jonathan Cape. London 2004. pp.628–644). According to the Alternative Ontology the tips of these rays represent the *temporal world*, whereas their lower part represents the "active past".

An event at the top of this network, resulting in the emission of a photon, is *not* to be understood as the emission of a more or less pion-like particle. Instead, according to the *Transactional Interpretation of Quantum Mechanics*, an "offer wave" (corresponding to the state vector of other interpretations\*) is sent out as a kind of search-light (the blue "triangle"). This wave (or wave-complex) is probably (almost?) instantly spread out in every possible (time-, light-, and spacelike) direction – probably wider than the partial light cone shown here – satisfying the conditions of the arrangement. (Imagine, for instance, how an outreaching screw may propagate a rotating movement at its base and instantly create an out- or incoming 'wave' along itself.)

Not until the series of processes of the atoms of the potentially reflecting mirror has grown to a point where an eventually reinforced interaction with an electron of one of its atoms is *possible* (cf. Richard Feynman's path integrals, or his popular account of photons in his book *QED – the Strange Theory of Light and Matter*, Princeton 1988), may a "confirmation" wave, sent back (in the "past") to the initial emitter, be responded to, and a transaction may occur. Such a transaction concentrates the flow of energy to a real standing wave, with a limited extension in space, i.e. a ray, which contributes to a network of an active "past". This account is a departure from the original TIQM and its classical, abstract spacetime, according to which the present moment is non-existent and, as a consequence, any relation between a temporal world and an active "past" as well. In that version the transactions are regarded as *atemporal* "handshakes across space-time". (However, in this article, <http://arxiv.org/ftp/quant-ph/papers/0507/0507089.pdf>, Cramer is a little closer to a process interpretation, even if he still refers to an abstract spacetime.)

The immediate distribution of the offer and confirmation waves means that any influence on a system of entangled particles immediately may affect distant parts of it. The paper by Antoine Suarez, [http://arxiv.org/PS\\_cache/quant-ph/pdf/0311/0311004.pdf](http://arxiv.org/PS_cache/quant-ph/pdf/0311/0311004.pdf), may exemplify this.

Updated December 19, 2007 / [Bo Herlin](#)

\* **Waves** may, most generally, be defined as *periodic changes* of any kind – always decomposable (according to Fourier) into a (often complicated) set of simple rotations (or sine-waves) representing periodically added amounts of change (superpositions).