Quantum entanglement[1]

If a Caesium atom releases two photons in opposite directions, quantum theory says they evolve as one entangled system with zero spin, but each photon still randomly spins up or down. So however far apart they get, if one photon is spin up the other is spin down, to maintain the initial net spin of zero. Yet if one is randomly up, how does the other *instantly know* to be down, at any distance? To Einstein, that measuring one photon's spin instantly defines another's anywhere in the universe was "*spooky action at a distance*". Bell's inequality, a prediction based on his thought experiment (Einstein, Podolsky, & Rosen, 1935), is the definitive test of quantum theory.

The test of Bell's inequality was one of the most careful experiments ever done, as befits the ultimate test of our reality, but quantum theory was right yet again. Observing one entangled photon caused the other to have the opposite spin even if it was too far away for a speed of light signal to connect them (Aspect, Grangier, & Roger, 1982). It was shown beyond doubt that quantum theory works, but again no physical basis was possible.

Entangled states are now common in physics (Salart, Baas, Branciard, Gisin, & Zbinden, 2008) but make no sense in physical terms. Two photons going in opposite directions are physically apart, so if each has random spin, as quantum theory says, why can't both be up or both be down? What connects them if not physicality? Nature *could* conserve spin by making one spin up and the other down from the start, but apparently this is too much trouble. It gives both photons both spins, then when one is defined, adjusts the other to match, *anywhere in the universe*.

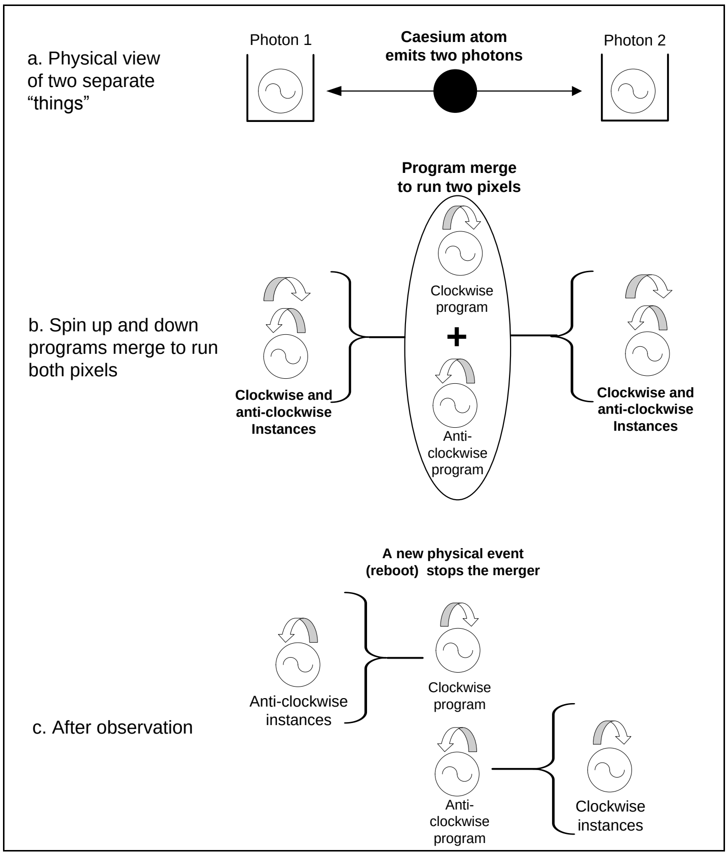

Figure. Entanglement as merged processing

In quantum realism, a physical event is programs overload the grid causing a reboot. If two programs interacting causes the overload, the reboot reloads both, i.e. "entangles" them. If two photons leaving a Caesium atom are entangled (Figure a), the same merged processing runs both of them (Figure b). Physically there are two photons, but in processing terms the spin up and spin down programs merge to run *both* sets of quantum state pixels. If either set interacts, the reboot restarts the spin up or spin down program depending on the instance involved, leaving the other photon with the opposite spin instructions (Figure c). Spin is conserved because the start and end code is the same.

Entity programs that merge in a reboot can't know the past because it is gone. So the merged code services both "photons" until another physical event starts a new entanglement. Entanglement is non-local for the same reason that quantum collapse is, that client-server effects ignore node-to-node limits. However far

[1] This is section 3.6.5 from Chapter 3 The Light of Existence, of the book Quantum Realism by Brian Whitworth, currently under development. The link gives a free early access to the whole chapter.

apart entangled photons travel, they still connect directly to their program source. In Bose-Einstein condensates any number of quantum programs can merge in this way.

Aspect, A., Grangier, P., & Roger, G. (1982). Experimental Realization of Einstein-Podolsky-Rosen-Bohm Gedankenexperiment: A New Violation of Bell's Inequalities. *Physical Review Letters*, *49*(2), 91–94.

Einstein, A., Podolsky, P., & Rosen, N. (1935). Can quantum-mechanical description of physical reality be considered complete? *Phys. Rev.*, *47*, 777–780.

Salart, D., Baas, A., Branciard, C., Gisin, N., & Zbinden, H. (2008). Testing spooky action at a distance. *Nature*, *454*, 861–864.