

Schrödinger's Equation and the Emergence of Time

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<https://www.youtube.com/watch?v=7L0oFeV0AeI&lc=UgxttM3Jbb3FG2SC8GN4AaABAq>

A comment on the YouTube *Closer to Truth* post:
Craig Callender - Setting Time Aright (January 1, 2023)

<https://youtu.be/7L0oFeV0AeI>

The concept of stationary solutions to Schrödinger's equation contains a subtle but essential twist: Composing stationary solutions from *linear* momentum components requires occasional ("particle in a box") or continual (orbitals) replacement with new, differently oriented momentum components.

This process of momentum function replacement requires briefly confining the momentum vector within a local approximation of what, at classical scales, we call xyz space. For example, when a sun photon radiating out in all directions encounters a NASA solar sail, it becomes, at that moment, vastly more localized in xyz space than before its reflection, despite never being absorbed by any specific particle in the sail. The photon and solar sail share and record a brief and remarkably private exchange in which both say, we are here.

An ordinary stationary wave function is a paradox standing openly in front of us. It is a collection of linear momentum waves that self-confine and begin anew in a small, private xyz space each time an internal energy potential redirects them.

Such minute sharings of agreement on mutual locations are essential to time because the mystery of time begins with the mystery of its perpendicular coordinate set — the xyz-like ability of two or more entities to say, Who-like, "We are here! We are here!" A proton and the electron remain bound and known to each other in their own local space by continually finding, binding, and redirecting each other's linear momenta, a process better known as acceleration.

And here's a surprise: This process of self-confinement by acceleration is identical to the "mystery" of wave collapse. Far from depending on some distant or omniscient observer, wave collapse begins with the tiniest of entities grasping each other like desperate lovers in the middle of a terrible storm of uncertainty. Like fish in water, we fail to see ordinary mutual acceleration as wave collapse because it is the essence of the always-localized classical world from which our ability to wonder about such things takes place.

Defining a location in space is the first and most fundamental step in defining time's direction. That's because wave function change confined within a tiny, fragmentary bit of xyz space becomes something new: The earliest tickings of a repeating clock. That ticking provides the only experimentally meaningful definition of the forward motion of time.

A warning: Due to at least a century of casual and deep-set acceptance of the continuum school of mathematical interpretation of all experimental physics, the following thought experiment can be tricky for some. Forget the intellectually fascinating but experimentally

uninterpretable concept of "Planck" space. Ask a different question: In the case of hands-on, experimentally accessible physics, what is the tiniest physically meaningful event in which the ever-spreading momentum waves of Schrödinger's equation become localized in xyz space?

There is no need to descend into the mathematical chaos of energy-indifferent and (folks forget this) necessarily aether-like Planck foams. A far more straightforward and physically meaningful answer resides in the examples I've discussed: Whenever there is a binding force that redirects and thus relocalizes linear momentum components, both a bit of confining and thus cycle-enabling xyz space and thus also a fuzzy vector of time emerge naturally.

Such bottom-up units of time begin small and stay quantum-fuzzy with small particle counts. The emerging orthogonality between space and time sharpens quickly in multi-part, multi-scale bound systems that cancel those forces internally and thus no longer experience momentum changes as a whole. That lack of changes in linear momentum allows time vectors that were at first fuzzy and indistinct to consolidate into sharp, classical-scale definitions of time in which the bound systems at multiple scales need only follow the acceleration-free geodesics of general relativity to define their time vectors.

The critical point is that one can experimentally decipher time physics only with clocks. The dependence of clocks on acceleration and binding means, in turn, that one can only solve the nature of time by including the binding forces and potentials of ordinary matter and the Standard Model. The converse approach of assuming spacetime to be some perfect mathematical fabric that exists independently of the physical constraints of matter and energy is just sloppy thinking. It doesn't matter if such sloppy thinking has been popular for decades or centuries. To understand space and time better, all that is needed is to get back to what physics tells us in experiments. It cannot be determined by inherently noisy and, thus, deceptive elaborations of equations that long ago lost their connections to actual physics.

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