Quantum Wave Functions are Less Fundamental Than Conservation

Terry Bollinger
2022-08-26.11:52 EDT Fri
https://www.quantamagazine.org/where-do-space-time-and-gravity-come-from-20220504/#comment-5960943580

A Comment on the Quanta Magazine article:
Where Do Space, Time and Gravity Come From?
https://www.quantamagazine.org/where-do-space-time-and-gravity-come-from-20220504

Sean Carroll at 24:06 - *"… I think of the wave function as the fundamental thing, right? I think that's what exists in reality. And the wave function, like the wave function of this positron and electron, is utterly non-local."*

These statements are faith-based assertions in the pre-existence of mathematical continuums in the physical world. As with the wave continuum assumptions that led to the ultraviolet catastrophe conundrum over a century ago, these assumptions conflict badly with known experimental evidence.

Individual quantum wave functions are the lowest-resolution and least predictable wave phenomena in nature. The idea that such inherently low-resolution phenomena are more "fundamental" than the conserved quantum numbers within them stems from the idea that if you collect an infinitely large set of data on identically executed wave functions on identically configured equipment, the result is an infinitely smooth, infinitely precise wave function. This wave function is, by definition, more "perfect" than anything in the physical world. The problem, of course, is that this never happens in experiments.

A better approach is to describe what quantum wave functions are: Low-resolution outcomes in which conservation rules, not physically impossible perfect wave functions, dominate the dynamics.

As for non-locality, this fascinating and well-proven effect occurs only within the interior of the forward light cone of the *classical* event, such as a lab experiment, that creates the wave function. Off-the-shelf quantum encryption devices, for example, provide encryption only within the light cone of information transmitted from their entangled-wave creation events.

Carroll's emphasis on "utterly non-local" does not adequately reflect these critical speed-of-light limitations. It leaves the impression that newly created, local-only wave functions "instantly" impact events, via entanglement, on the other side of the universe. There is no evidence for that. Only photons that have paid the enormous light-cone-expansion cost of first traveling for billions of years through space can claim that scale of entanglement.

So again, while commendable in their honesty, Professor Carroll's statements are ones of mathematical faith, not laboratory science.

2022-08-26.11.52 EDT Fri
PDF: https://sarxiv.org/apa.2022-08-26.1152.pdf