On the Fourier Fuzziness of Reality

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Gmail Excerpt

Hi Mitch,

You made a good point, and I should have been more explicit in agreeing with it. I found your observation about sine and cosine introducing uncertainty into math insightful and deeply resonant with physics.

The Fourier transform resides about as deep in the foundations of the physical world as any concept in physics. The very basis of quantum theory is the interplay between the space view we prefer and the momentum view that baffles us, though the condensed matter folks do better than most in that odd domain. But even they tend to treat entities such as electrons in momentum space as if they still look like particles there. It's not that simple. For example, in momentum space -- in Fermi seas -- the entities we interpret as particle-like electrons take the form of almost infinitely thin nested shells.

I think of imaginary exponentiation as more fundamental than either sine or cosine. That's where sine and cosine combine to form the complex-plane helices (for the easier-to-visualize 1D subset) that are the deeper basis of quantum two-way Fourier conversions. At least in physics, the oversimplified flat projection of such helices into "just" sine or "just" cosine complicates and confuses things. If nothing else, such projections too closely resemble the rotating single-plane resonant solutions called "real." Dynamically, such solutions rotate in the complex plane and are no more "real" than any volume-enclosing helical forms. But for items such as atomic orbitals, electrons in boxes, or metal conduction energy bands, the single-plane or "skip-rope-like" solutions are, from a momentum perspective, the ones in which the same entity is going in two opposite directions at the same time, in equal measures. Such self-canceling of direction is fundamental to spatial locality, though not always in obvious ways.

Your position thus feels to me like one of those areas where physics is gifting us with just the kind of convergent limits that our efficiency-first biological brains handle best. Trig is part of physics, but only as a limit algorithm built into our physics hardware.

One analogy I've begun using is the Strandbeest Universe. I don't recall if I've mentioned that model before to you. The idea is that the universe starts with many instances of quantities -- some discrete and others not -- that are all conserved, though self-canceling pair creation is permitted. In unison, a large number of these can implement concepts such as trig to any degree required: https://sarxiv.org/apa.2022-05-29.1836.pdf

It's still a math-based universe, but one that starts with discrete entities that can occupy vast volumes of spacetime without losing integrity. We call such diffuse entities photon and Schrödinger wave functions. Coordinated use of large numbers of such entities can approximate any degree of classical smoothness. HAWC demonstrated that nicely by showing how high-energy gammas require space to be too smooth to support Planck-scale superstrings.

("Superstring theory" is the correct name for the math-only extrapolation of the superbly data-based nucleon-scale "string theory" of the 1970s down into the experimentally meaningless Planck scale. Bona fide string theory is incredibly well-proven, but a bit boring since the strings are just the color and electric forces, and the weights at the ends of the vibrating strings are just quarks.)

That kind of iterative, conservation-driven smoothness is a very different form of discreteness from a "binary bit" universe. Bits are nothing more than a more subtle way of re-introducing Minkowski's infinite perfection, only this time via the absolute certainty assumed for each bit state. Real bits only approach certainty asymptotically, and they become more classical as they do so -- a genuinely horrid starting point for quantum computing approaches that then try to quantize them.

Enough ranting! I get annoyed that a philosophical lust for perfection derailed a century of physics theory. Einstein should have stuck to his guns for using only physical clocks to define his relativities.

Cheers,
Terry