Wave Electrodynamics (WELD)

Wave Electrodynamics (WELD) is the likely non-tenant idea that the coupled Maxwell-Dirac equations (pure waves, no particles) could provide a complete model of electrodynamics. It is a compelling model at many levels, within a larger (and many would argue, hopeless) attempt to articulate an actually physical, autonomous model of physics, of the sort that seemed so tantalizing close at the dawn of the 20th century, before Quantum Mechanics (QM) made everything so incomprehensible. However, seems to have two critical failures, which also serve to motivate a why for the central puzzling wave-particle duality of QM:

- Pure waves fall into the sea, inevitably -- they just diffuse away into blobs of chaos. Anyone who has observed waves in a liquid medium is familiar with this phenomenon. Somehow there was a hope of achieving robust emergent localization through the coupled dynamics of multiple wave equations, but this seems unlikely to happen robustly enough to account for the apparently crisp and constant nature of things like the charge of electrons.
- By analogy, pure analog computers are not practical -- they quickly become swamped by noise. The pragmatic benefit of digital rectification is to constantly fight against this noise, cleaning up the signal and enabling robust, stable computation. The same benefit is presumably conferred by the particles of nature. This may be a powerful analogy, in terms of thinking about the relationship between waves and particles -- particles are "digital" rectifications of an underlying analog wave signal? There are important functional benefits of both analog and digital dynamics, so somehow nature is leveraging the best of both?
- Locality: a major feature of the pure wave approach is also its apparent downfall: wave dynamics arise very naturally from local interactions, automatically obeying a speed-of-light constraint in their propagation. But, in the few years since this project was started, new experiments have finally closed all the loopholes, and it seems like it is no longer possible to avoid the truly bizarre and challenging fact of non-locality in the case of entangled particles. Is there any way we can try to make sense of this phenomena? No harm in trying :) Perhaps the digital / analog computational analogy can provide some leverage here? Other approaches to consider: the Bohm pilot wave framework puts all the non-locality into the guiding wave, and not into the particle -- perhaps spacetime local particles are bouncing around in a fourier field that is non-local in spacetime but nevertheless obeys its own kind of mechanistic logic, which we could potentially understand.

Thus, this project is, inevitably, a work in progress. Here are major points of entry with rough dates of latest update:

- 2018: Phenomenology -- an attempt to sort through the overall scope of physics phenomenology and how different physical models could potentially make sense of these phenomena. This serves as a broad guide map to the overall approach taken here.
- 2012-13: WELDBook -- An introduction to Wave Electrodynamics, designed to be accessible to someone with basic physics and calculus background, using numerical simulations and intuitive graphical displays to make the material concrete and accessible.
- EmeWave -- Numerical wave simulation software built on top of the Emergent simulation framework.
- Bibliography -- Annotated bibliography and actual papers (PDFs) for the key published work in this field.
Article Sources and Contributors