Quick Recipe for Quantization: Why, What, and How

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There are many ways and whats to quantize. Here we seek to explain some of the whys, whats, and hows of the impedance approach to quantum field theory.

Why impedances?

Impedances govern the flow of energy. The Hamiltonian and Lagrangian approaches look at energy conservation and its flow between kinetic and potential. Impedances govern the flow of that energy. There is geometric and topological information in the impedance approach that is not accessible in the Hamiltonian and Lagrangian approaches. Can't get here from there.

What is impedance?

Impedance is a measure of the amplitude and phase of opposition to flow of energy. Classically, impedance is a geometric concept. In the quantum world there exist topological impedances as well. Our interests here are in the geometric impedances of quantized inductance and capacitance, and the quantum phase coherent topological impedances, both measured in ohms.

*What is impedance **matching**?*

What matters in propagation of energy is not the absolute value of impedance (which defines the ratio of voltage to current, but not the value of either), but rather the relative impedances of the geometric and topological objects that share energy. If the impedances are equal there are no reflections. If there are mismatches, energy is reflected.

What are the geometric and topological objects of the impedance model, and what properties beyond geometry and topology do they possess?

The objects are the simplest possible for a realistic model - quantized flux (no singularity), charge (one singularity), and dipole moment (two). Two varieties - magnetic and electric.

OK, we have whys and whats. How about hows?

First one has to define a quantization scale. In the impedance model we take this to be the Compton wavelength of the electron.

Then one takes the objects of the model - quantized flux, charge, and dipole moment - to be confined by the impedance mismatches as one moves away from the quantization scale.

Finally, one calculates electromagnetic impedances of interactions between these objects. One would think this step could be accomplished directly, perhaps via classical electrodynamics in the Geometric Algebra of Hestenes and collaborators. In the present approach mechanical impedances of the interactions are calculated and converted to electromagnetic.

How is this related to QED?

QED calculates perturbations of point particles in powers of the fine structure constant with part-per-billion accuracy. In the impedance model the electron has structure. That which governs the flow of energy, the quantized impedance network of that structure, is precisely ordered in powers of the fine structure constant. This is why QED works so well.

Tell me again why we're doing this.

Impedances govern the flow of energy. There is geometric and topological information in examining the role of impedances that is not accessible in QED, or quantum field theories in general. Can't get here from there. Peek down the rabbit hole. See quantized impedances.