Quick Recipe for Impedance 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 model.

Why impedances?

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

What is impedance?

Classically, impedance is a geometric concept. In the quantum world there exist topological impedances as well. Our interest here is both the geometric impedances of inductors and capacitors, and the quantum phase coherent topological impedances, as measured in ohms.

What is impedance ***matching****?*

What matters in the propagation of energy is not the absolute value of the 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 the 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 impedance mismatches as one moves away from the quantization scale.

Finally, one calculates the electromagnetic impedances of the interactions between these objects. In principle one would think that this step can be accomplished directly, via Maxwell's equations in the language of geometric algebra. That's the goal. In the present approach the mechanical impedances of the interactions are calculated and converted to electromagnetic.

How is this related to QED?

QED calculates via 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 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 the Hamiltonian and Lagrangian approaches. Can't get here from there. Take the easy way, via quantized impedances.