Review of: "Kirchhoff Coupling Generates ATP, the Chemical Energy of Life"

Lars Wegner

Potential competing interests: No potential competing interests to declare.

I have no objections against the key message of the author that the Maxwell-Ampere equation and the Kirchhoff equation derived from it matter to both biology and engineering, and that they are valid at all scales. This is certainly true, but has not been doubted as far as I know. I also agree with the statement that the mechanism of current and the particles carrying it – after all this allows us to do electrophysiology, coupling biological and technical systems in one electrical circuit.

However, I am puzzled by the statement that molecular dynamics modelling does not account for charge movement. In fact it does, though at a very limited time scale. Have a look e.g. at the following paper: Ing C. Pomes R. Simulation studies of ion permeation and selectivity in voltage-gated sodium channels. Curr. Top. Membr. 2016; 78: 215-260. The good thing is that you can choose for a coarser approach in terms of spatial resolution if your computer can’t do it, applying a finite-element-approach.

I am not familiar with the details on electron/H+ flow in mitochondria, but if I understand the author correctly he suggests analogue circuits as a tool to formalize these processes. Using analogue circuits is a well-established approach to describe charge movement in biological systems quantitatively. I guess that Hodgkin and Huxley in their famous paper on action potentials were the first to do so, but I didn’t follow that up. While the approach itself is undisputed, the question is if the chosen circuit is adequately reflecting the biological system it is supposed to describe. Moreover the chemical aspects (shifts of ion species, use chemical energy…) are not reflected by an analogue circuit, limiting its validity.

Minor comments:

- Please explain parameters in your equation
- Complex IV catalizes the final electron transfer to O2. The ATPase for ATP production is complex V.