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Interactive comment on "Fundamental molecules of life are pigments which arose and evolved to dissipate the solar spectrum" *by* K. Michaelian and A. Simeonov

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This paper to me provides the type of mechanism which is likely to be how life and photosynthesis evolved on Earth. It integrates our known knowledge about photochemical reactions and the properties of the pigments in cells such as nucleic acids, aromatic amino acids and enzymatic co-factors were driven by Non-Equilibrium Thermodynamics in increasing the rate at which solar photons were dissipated and in the process created the complex machinery of life. The cell structure increased the cross-sectional area thereby increasing the rate at which solar photons were dissipated and the cell membrane isolated the cellular biochemistry from the external environment. These

events necessary for the evolution of life as we know are so neatly inter-related to one another through Non-Equilibrium Thermodynamics.

For example, the proliferation of autocatalytic photochemical processes is consistent with Non-Equilibrium Thermodynamics increasing the rate at which solar photons were dissipated. This also fits neatly with Lokta's (1922) hypothesis that selection will favour anything that uses free energy to maintain itself and increase its own numbers. The origin of Life and its evolution is driven by Non-Equilibrium Thermodynamics as so clearly illustrated in this paper by Michaelian and Simeonov.

I like the way in which the authors have related the changes in the characteristics of our Sun and their impact on the evolution of life on Earth and the suggested timeline for these changes. Integrating a diverse range of information strengthens the argument that the authors put forward in this paper. It reinforces the fact for me that biological systems are organised by the same principles that organise the physico-chemical realm. That is a powerful argument in its favour.

The authors provide detail to support their thesis. For example, the nucleic bases adenine, uracil, guanine and cytosine and their Watson and Crick pairings is explained in terms of their capacity to dissipate free energy in 240-290 nm during the early Hadean and Archean atmosphere. The stability of cholorphyll a in the presence of these photochemical processes as well as its aggregation rapidly converting UVC to UVA.

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