

# Barking Up the Wrong Tree for Life?

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## Abstract

The fundamental problem with the Penrose (1) and Loewenstein (2) attempts to explain long range communication in biology and consciousness in the brain is that the mass of the particles associated with electromagnetism and chemistry are too big for quantum coherence to occur at room temperature over cellular and intercellular distances. The electron neutrino (and its associated weak force) weighing in at between  $0.1\text{eV}/c^2$  and  $2.5\text{eV}/c^2$  is a much more likely candidate for overall organisation and communication within and between cells.

**Key Words:** Penrose-Hameroff model, long range communication, quantum coherence, biology

NeuroQuantology 2007;1:186-187

The fundamental problem with the Penrose (1995) and Loewenstein (2000) attempts to explain long range communication in biology and consciousness in the brain is that the mass of the particles associated with electromagnetism and chemistry are too big for quantum coherence to occur at room temperature over cellular and intercellular distances. The electron neutrino (and its associated weak force) weighing in at between  $0.1\text{eV}/c^2$  and  $2.5\text{eV}/c^2$  is a much more likely candidate for overall organization and communication within and between cells.

While quantum coherence is possible on atomic, inter atomic and inter

molecular scales up to about 10nm, the theory is simply not plausible at cellular and intercellular distances at room temperature. The maximum temperature at which wave like behavior can be observed in a system of particles is given by  $h^2/3kma^2$  (Loewenstein, 2000), where  $h$  is Planck's constant,  $k$  is Boltzmann's constant,  $m$  is the mass of the individual particles and  $a$ , is the mean spacing between particles. The maximum temperature is inversely proportional to  $m$ . The smallest particle associated with the electromagnetic force and chemistry is the electron. This means that the highest temperature at which quantum coherence can occur over cellular scales ( $10^{-6}\text{m}$ ) is

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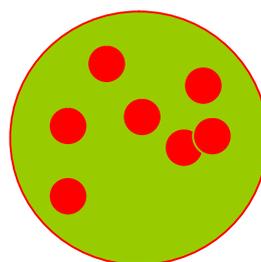
0.01K. Therefore, if quantum coherence is occurring over cellular distances at room temperature it cannot be electromagnetic in nature nor have a chemical origin.

I spent most of the 1980's trying to identify a pattern in the key structures, the fundamental particles and forces found in nature. Symmetry arguments lead to the disturbing conclusion that the key to a physics based theory in Biology was the electron neutrino and weak force (Goodman, 1994; 1997). In accepting this, one got rid of numerous qualitative and quantitative inconsistencies between the known sciences, particles, structures and forces. Such reduction in inconsistencies is indicative of being on the right track in science. It also provided answers to such obvious questions as to why cells are all typically a few microns in size. The qualitative arguments were backed up by a theory that predicted that the neutrino mass should be  $\sim 0.23\text{eV}/c^2$  ( $4 \times 10^{-37}\text{kg}$ ). This was two orders of magnitude below accepted limits at the time. As work on determining the mass of the neutrino (Araki, 2005; Aliu, 2005) continues it is now widely thought that the mass of the electron neutrino will end up between 0.1 and a few  $\text{eV}/c^2$ . The highest temperature at which quantum coherence can occur over cellular distances ( $10^{-6}\text{m}$ ) between neutrinos

of this mass is well above room temperature (e.g. 26,500K for a neutrino of mass  $0.23\text{eV}/c^2$ ). In short, quantum coherence enthusiasts may be looking in the wrong place for their singular quantum states of consciousness in the brain.

Finally, a physics based quantum theory of Biology (Goodman, 2003) should begin, by analogy with the developments in Chemistry, with a "*J. J. Thomson plum pudding model*" of the cell (Fig.1) and move on to the particle (neutrino) in a one dimensional box of cellular size, model. Now that neutrinos have mass there is no theoretical reason why they can't slow down e.g. in gravitational fields. God alone yet knows what low energy neutrino's have in store for us. For those who might be skeptical about such a tiny mass (neutrino) being responsible for overall organization and communication within and between cells it is instructive to remember that the nucleus which contains more than 99.9% of the matter in the atom, although vital to the existence of an atom, plays only a minor part in the chemistry of atoms and molecules.

**Figure1.** The Thomson "plum pudding" model of the cell. The red dots represent neutrinos in a cell.



## References

- Penrose, R. *Shadows of the Mind*, Vintage, London, 1995, pp348-388.
- Loewenstein, W. *The Touchstone of Life*, Penguin, London, 2000, pp389-410.
- Goodman, M. Key self-organising systems., *Proceedings of the 1<sup>st</sup> ICASSE*, June 1994, pp118-125.
- Goodman, M. Toward linking material self-organisation and the weak force. *Speculations in Science and Technology*. March 1997;20:33-43.
- Araki, T. et al. *Phys Rev Lett* 2005 ;94:081801-1.
- Aliu, E. et al. *Phys Rev Lett* 2005 ;94:081802-1.
- Goodman, M. Symmetry points the way to the beginnings of a fundamental theory underpinning Biology. *Symmetry: Culture and Science*. 2003;14:265-269.