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Are we quantum computers, or merely clever robots?

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Abstract

Of course quantum information processing is not possible in the warm wet brain. There is, however, one “loophole” - offered by nuclear spins - that must be closed before acknowledging that we are merely clever robots. Putative neural quantum processing with nuclear spins seemingly requires fulfillment of many unrealizable conditions: for example, a common biological element with a very isolated nuclear spin to serve as a qubit, a mechanism for quantum entangling qubits, a mechanism for quantum memory storage and processing, a quantum to biochemical transduction that modulates neuron firing rates, among others. My strategy, guided by these requirements, is one of reverse engineering seeking to identify the bio-chemical substrate and mechanisms hosting such putative quantum processing. Remarkably, a specific neural qubit and a unique collection of ions, molecules and enzymes is identified, illuminating an apparently single path towards nuclear spin quantum processing in the brain.



Matthew Fisher is a theoretical physicist determined to bring quantum mechanics down to earth. After earning his PhD in 1986 from the University of Illinois, Matthew was a Research Staff member at IBM's Watson Research Center. Since 1993 he has been a Professor of Physics at UC Santa Barbara, except for a brief stint at Caltech in 2009-2010. In 1995, Matthew received the Alan T. Waterman Award bestowed by the National Science Foundation, and has also been the recipient of the National Academy of Sciences Award for Initiatives in Research (1997). He was elected as a member of the American Academy of Arts and Sciences in 2003 and to the National Academy of Sciences in 2012. Matthew was a co-recipient of the 2015 Oliver E. Buckley Prize in Condensed Matter Physics given by the American Physical Society.

In recent years Matthew has turned his attention to the fledging field of “quantum neuroscience”, seeking to determine whether quantum processing with nuclear spins might be operative in the brain. The question: Are we quantum computers, or merely clever robots? is the central motivation.

