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Subject: Penrose Institute
Date: Wed, 24 May 2017 16:23:37 +0000
Attachments: TSC2017_BookofAbstracts_COVER.pdf.pdf

Hi Jeffrey

I forgot the abstract book cover and inside cover, attached here. Thanks again for your help!
Its been quite a job transplanting the conference from Shanghai but its going to be quite good,.

Not to press my luck, but I wanted to mention the Penrose Institute.
Below is a draft of what i see as my area which could use some seed money.
If you're coming to the conference we're having a dinner Sunday night June 4.

Thanks again!
Stuart

The Roger Penrose Institute

The Roger Penrose Institute is being launched at UCSD to develop Sir Roger's ideas regarding consciousness, non-computable creativity, fundamental physics and cosmology. These ideas cut across disciplines, and complement (or in some cases disagree with) conventional views in neuroscience, artificial intelligence ('AI'), physics and cosmology. But these conventional views have either failed, or require unproven excess 'baggage' to make sense and ring true.

Principals and organizers of the Penrose Institute include Sir Roger Penrose (Emeritus Professor at the Mathematical Institute of the University of Oxford, author, and winner of the Copley Medal and the Wolf Prize in Physics, shared with Stephen Hawking), James Tagg (inventor, author, entrepreneur), Erik Viirre (UCSD neurologist, co-director of the UCSD Arthur C. Clarke Center, X-Prize manager), Ivette Fuentes (University of Nottingham physicist and inventor), and Stuart Hameroff (anesthesiologist, professor and Director of the Center for Consciousness Studies at the University of Arizona).

The intended mission of the Penrose Institute includes 4 general research areas: 1) non-computable aspects of human thought and cognition (James Tagg), 2) quantum and sub-neuronal biology (Stuart Hameroff, Erik Viirre), 3) new approaches in quantum physics, e.g. testing OR, quantum AI, and using desktop Bose-Einstein condensates to detect gravity waves, e.g. for earthquake early warning (Ivette Fuentes, Roger Penrose), and 4) cosmology, e.g. evaluating Roger's ideas regarding a cyclical universe (Roger Penrose and others).

Specific lines of experimentation in each of these areas include:
1) James
2) see below, me and Erik
3) Ivette (suggest including Hartmut Neven, head of Quantum AI at Google, and able to test OR in their D Wave quantum computer
4) Roger, others

2) Quantum and sub-neuronal biology

Conventional views portray the brain as a computer composed of neurons acting as inanimate bits and switches, with consciousness emerging at some critical threshold of complex computation, and generally considered an epiphenomenal illusion.

But the presumed threshold for emergence of consciousness is unknown and the computational basis for consciousness is an unsubstantiated assumption. While much can be learned from these approaches, including brain mapping, imaging etc., it appears the ultimate answer to how the brain produces consciousness cannot be reached through these approaches alone. Something is missing, and we believe Roger's ideas are necessary to understand the brain, to understand consciousness.

In his 1989 book 'The emperor's new mind', Roger Penrose proposed that consciousness required some 'non-computable' factor, something outside of, or deeper than, the brain's neuronal-based computational architecture. He argued that consciousness and ‘understanding’ were not strictly computations, and suggested that a non-computable factor was required, a factor derived from quantum physics, an 'objective' threshold for self-collapse ('reduction') of the quantum wavefunction which would convert multiple non-conscious possibilities to specific conscious perceptions or actions. He termed this mechanism 'Objective Reduction' ('OR'), in which the objective threshold for quantum state reduction was rooted in the fine scale structure of the universe. Poorly understood and considered 'exotic', Roger's 1989 OR proposal remains the only actual specific mechanism for consciousness ever put forth. It also potentially solves the measurement problem in quantum mechanics, and connects quantum theory to general relativity.

Roger needed a brain-based quantum structure for OR which could influence neuronal, network and brain activities. When Stuart Hameroff read 'The emperor's new mind' in the early 1990s he had, for 20 years, been studying microtubules, cytoskeletal protein polymers inside neurons which organize their functions and regulate their synapses. Microtubules are cylindrical polymers composed of 'tubulin', the brain's most prevalent protein, arrayed in microtubule walls as hexagonal lattices, slightly skewed to give Fibonacci pattern geometry. Hameroff had long thought, and written about ,microtubule information processing capabilities, but hadn't considered quantum processes. He suggested to Roger that microtubules could be the quantum devices inside neurons he needed to organize (‘orchestrate’) OR events, linking neuronal function to non-computable factors in the fine scale structure of the universe.

Penrose and Hameroff began to develop a theory based on microtubule quantum computations inside neurons, computations which evolved as quantum superpositions until reaching Roger's OR threshold for collapse of the wavefunction after a critical time t. At that instant, they suggested, a moment of conscious experience/feelings/awareness occurs, and specific states and patterns of tubulins in microtubules are selected, states which then regulate synapses and trigger neuronal firings. Synaptic inputs, vibrational resonances and encoded memory were proposed to 'orchestrate' microtubule quantum resonances leading to OR, hence 'Orchestrated Objective Reduction' ('Orch OR').

The Orch OR theory was viewed skeptically and criticized by mainstream neuroscientists, physicists and AI proponents, but evidence in the past 10 years has supported Orch OR while mainstream efforts to understand consciousness have failed. Microtubules have been shown to have quantum vibrations and resonances at varying frequencies, and are known to disassemble and become dysfunctional in Alzheimer's disease. Moreover, anesthetic gases which selectively erase consciousness, and are presumed to act at membrane receptors and ion channel proteins, now appear to exert their effects by dampening quantum vibrations in microtubules inside neurons. Indeed, the brain appears to act as a hierarchical, multiscalar dynamical system extending downward inside neurons to quantum vibrations in microtubules, more like an orchestra than a computer.

Led by Stuart Hameroff and Erik Virile, Penrose Institute research related to quantum and sub-neuronal biology and consciousness include 4 specific experimental avenues. These are:

a) Clinical applications, i.e. treatments for mental and cognitive disorders based on sub-neuronal and quantum processes. Conventional approaches primarily consider therapies aimed at membrane receptors, with mixed and generally disappointing results (e.g. SSRI antidepressants presumably acting at serotonin receptors, but take several weeks to act, apparently due to necessary rearrangement of the microtubule cytoskeleton). We intend to test and design drugs, and develop non-invasive brain stimulation therapies aimed at vibrational resonances in microtubules inside neurons. These include transcranial electrical, magnetic, photonic and ultrasound brain stimulation which alter mental and cognitive states, although how they do so remains unknown. However it appears they may act via microtubule vibrations rather than neuronal membrane activities as is often assumed. These technologies are safe, and bring significant potential for clinical breakthroughs, patents and products. For example, transcranial ultrasound has been shown to safely improve mood in humans, and reverse Alzheimer's disease in animals. Microtubules disassemble in Alzheimer's disease, resonate in megahertz (ultrasound frequency), and experiments show megahertz stimulation promotes microtubule assembly. At the University of Arizona, we are doing clinical studies of transcranial ultrasound on patients with Alzheimer's dementia. Drug therapies aimed at Alzheimer's and based on conventional approaches have failed.

b) Quantum optical experiments on whole (animal) brains and brain slices, as done by Robert Alfano at CUNY. His group has shown that photons pass through the brain, and retain quantum entanglement. This suggests that quantum entanglement may occur naturally in the brain, a feature which would help explain 'binding' and other aspects of brain function and consciousness. Combining these experiments with effects of anesthetics and psychoactive drugs would help pinpoint the mechanism of consciousness, and serve as a testbed for drug design which could help patients and also garner patents, products and money.

c) Nanotechnology using methods pioneered by the group of Anirban Bandyopadhyay at NIMS in Tsukuba, Japan. For example, they have been able to apply 4 nanoprobes to a single microtubule to measure its conductances at specific applied alternating current frequencies. They find apparent quantum conductance at specific frequencies in terahertz, gigahertz, megahertz and kilohertz bands. They also inserted nanoprobes inside active neurons to access microtubules, and in both sets of experiments have found self-similar resonance patterns, suggesting a fractal-like quantum behavior in microtubules. Again, combining these experiments with anesthetic and psychoactive drug effects could lead to patient benefit, as well as patents, products and financial gain.

d) Computer simulation of microtubules and their component protein tubulin show collective terahertz quantum vibrations, consistent with experimental findings of Bandyopadhyay's group. The terahertz vibrations in tubulin and microtubules are due to pi resonance (quantum) dipole oscillations in aromatic rings of amino acids such as tryptophan (which also mediate the quantum optical effects Alfano and his group have shown). Anesthetic molecules selectively erase consciousness, sparing non-conscious brain activities, however the mechanism by which they do so remains unknown. Work by Travis Craddock, Jack Tuszynski and I has looked at simulated effects of anesthetic molecules on these terahertz vibrations in tubulin/microtubules, and shows dampening which correlates with anesthetic potency. While mainstream views assume anesthetics act on membrane proteins, the evidence (genomics, proteomics etc) actually points to anesthetic action on microtubules, and we appear to have found the specific mechanism,
dampening collective terahertz quantum dipole oscillations. This effect can provide a simulation testbed for

drug design for anesthetics and psychoactive drugs, for example antidepressants. Considering quantum vibrations in microtubules as the underlying basis for consciousness opens a new vista of drug design and therapies.

Some of these experimental approaches can be done on site at the Institute, and others via collaboration with other groups as described above. All are feasible, cost-effective and hold promise for advances in clinical care, patents and products, as well s furthering understanding of the nature of consciousness and understanding the brain.