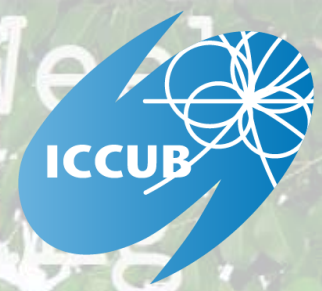


18th Brainstorming Week on Membrane Computing



February 4-7, 2020

Sevilla, Spain

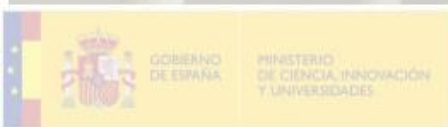
One Interesting Problem

Understanding Intelligent Life

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Motivation

- Further results beyond original ideas by Roger Penrose:
 - The Orch OR theory proposes quantum computations in brain microtubules account for consciousness. “Consciousness in the universe: A review of the ‘Orch OR’ theory” S. Hameroff, R. Penrose.
<https://doi.org/10.1016/j.plrev.2013.08.002>
 - Non-trivial quantum processes have been observed in living systems:
 - “Revisiting the Quantum Brain Hypothesis: Toward Quantum (Neuro)biology?” P. Jedlicka. <https://dx.doi.org/10.3389%2Fnmol.2017.00366>
 - “Long-lived quantum coherence in photosynthetic complexes at physiological temperature” G. Panitchayangkoon et al.
<https://doi.org/10.1073/pnas.1005484107>
 - “Quantum coherence in biological systems” S. Lloyd.
<https://iopscience.iop.org/article/10.1088/1742-6596/302/1/012037/pdf>
 - “Efficient estimation of energy transfer efficiency in light-harvesting complexes” A. Shabani et al.
<https://journals.aps.org/pre/abstract/10.1103/PhysRevE.86.011915>
- Quantum Life: <https://www.youtube.com/watch?v=wcXSpXyZVuY>



The vision

- Understanding emergence of different biological properties as a result of their quantum complex nature:
 - Life
 - Self consciousness
 - Recognition of peers
 - Group behavior
 - Freedom of choice
 - Intelligence
- Apply the scientific method to validate models that allow to explain at a certain level the above properties



The idea

- Humans, and in particular human brains, are **highly complex quantum systems** that are able to **observe themselves** and thus, following the rules of quantum mechanics, are able to modify their own structure.
- Furthermore, we are the result of a complex connection of a number of quantum complex systems: cortex, hypothalamus, spine, peripheral neural system, heart, guts, ...
- Additionally each one of us interacts with many others.

What needs to be done



- Study the emergence of complexity
- Study Quantum properties:
 - Waveform / particle duality
 - Probabilistic
 - Non-locality
 - Indetermination principle
 - Non-causality
 - Non-deterministic
 - Schrödinger paradox
 - Entanglement
 - Collapse of the wave function under external observation
- Interphase between classical and quantum macroscopic behavior
- Find appropriate operational definitions
- Simulations
- Define an experimental roadmap.