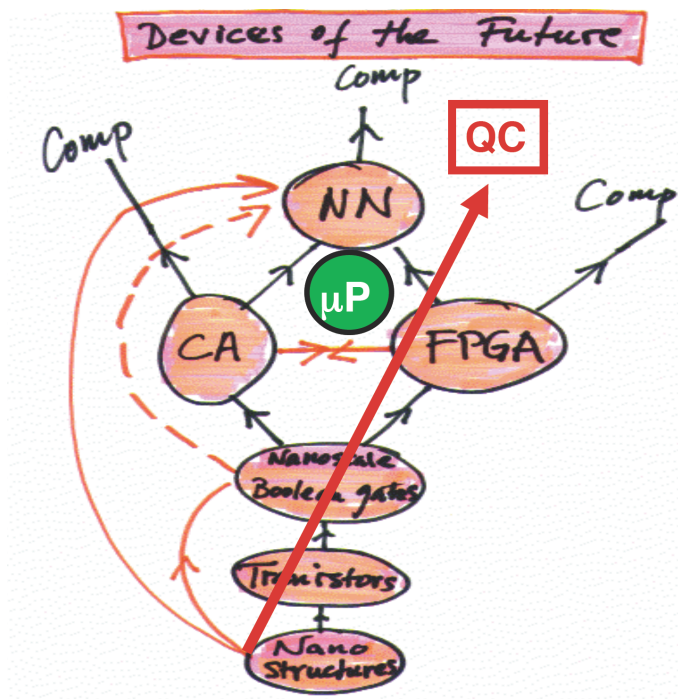


Quantum Physics Unleashed



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(Human) Biology and Quantum Physics

From quantum chemistry and transport
to
coherence and entanglement
to
quantum consciousness.

Quantum Physics out of control ?

Human biology and Quantum physics

My personal aim is to:

- Describe to a broad audience how quantum physics is relevant for biology - **quantum biology**
- Describe various **biological (quantum) sensors**
- Demystify the concepts of **coherence and entanglement**, at least in the context of Qbio.
- Analyse various "educated" **speculations about classical-quantum coexistence**
- Comment on Quantum Mind, Quantum Consciousness
- Comment on Philosophy and Quantum Physics
- Comment on Qbism (new discovery of mine)

There are particularly two recent views that I would like to pay attention to:

Thomas Nagel: Mind and Cosmos:
Why the Materialist Neo-Darwinian Conception of Nature Is
Almost Certainly False

Stuart Kauffman: Answering Descartes: Beyond Turing
Stuart Kauffman et al., Quantum biology on the edge of
quantum chaos
→ Stuart Kauffman's **Poised Realm**

Thomas Nagel, Professor, Philosophy:

Department of Philosophy and the School of Law at NYU.

Mind and Cosmos:

Why the Materialist Neo-Darwinian Conception of Nature Is Almost Certainly False (Oxford, August 2012)

The present natural science view of the world is "almost certainly false" because **science cannot explain** a number of **key questions**, in particular the emergence of life "out of nothing" and the presence of a **"subjective conscious mind"**

My own response:

The present natural science view is "almost certainly true" because Physics, Chemistry, Biology, Information theory, ... are most likely powerful enough to be able, **given infinite time**, to explain the evolutionary emergence of life and an associated conscious **classical mind**.

As well as a **quantum mind**, if there is one

Not a computable problem, but Perhaps can be simulated ?

Conjecture 1: Philosophers are unable to understand the explanation power of Physics.

Conjecture 2: Quantum Physics fills a role similar to snake oil, magnetic bracelets, astrology, new age, new wave, D-wave ☺,

The "simple" truth is not very interesting.

Most people are looking for the ultimate truth, preferably out of this local world'

Conjecture 3: The simple truth may not be so simple, after all just try Qbism

Stuart Kauffman's **Poised Realm**

- Motivated by a conviction that **present approaches** (classical neurobiology, classical physics) **cannot explain the human mind**.
- Also driven by ideas/concepts from Philosophy and AI
- Expressed in terms of the **need for going beyond Turing machines** - Trans-Turing Systems (TTS)
- Invokes Quantum Physics in at least 2 ways
 - **driven classical-quantum hybrid systems**
 - **long-range entanglement** for cognitive properties

Poised Realm - driven classical-quantum hybrid systems on the edge of quantum chaos (Kauffman's vision)

- Localized - extended states
- Power series - exponential decay
- Quantum states with long coherence times
- Decay and recurrence of coherence
- Transitions between quantum and classical states via measurement and re-coherence (GW ???)
- System "hovers" between deterministic and non-deterministic behaviour (GW ????)
- Trans-Turing System
- Allows responsible "Free Will" (GW question)

Long-range quantum entanglement for cognitive properties (GW ???)

Roger Penrose

Stuart Hameroff (microtubules; quantum soul...)

Quantum biology (photoconversion, avian
magneto-orientation, olfactory sensing, ...,
microtubules,)

Stuart Kauffman (the Poised Realm; classical-
quantum co-existence; control, feedback).

Quantum mind/consciousness

QBism, subjective probabilities

On top of that: **Biocentrism, Robert Lanza**

<http://www.youtube.com/watch?v=CRkDicwjRQs>

Notion of a Conscious Universe

While physics is considered fundamental to the study of the universe, and chemistry fundamental to the study of life, **biocentrism tries to place biology before the other sciences to produce a theory of everything.**

Lanza has claimed that future experiments, such as **scaled-up quantum superposition**, will either support or contradict the theory.

Why bother ?

Not even journalists always get it right!

Just ask Peter Byrne or Faye Flame:

Wed 30 Jan 2013

2:00 PM - Journalist in Residence Talk

Peter Byrne, Peter Byrne Ink

Hype, Censorship, and the **Paranoid Style in Science Writing**

Fri 1 Feb 2013

3:30 PM - Journalist in Residence Talk

Faye Flam, KITP Journalist in Residence

Life on Mars and Neanderthal Clones: **Why Weird Science Gets on the Front Page and What You Can Do About It**

We should bother because

there is a huge lack of people's understanding of the technologies they are using

there is rapid build-up of knowledge

- Huge, and increasing, gap in understanding
- Mystification becomes attractive
- Fantasy and reality fuse together ?

→ mystification of science maybe dangerous in the long term

How to distinguish valid speculations from invalid, but not obviously crackpot, speculations ??

Physics education does not guarantee a critical mind or even proper understanding

It is remarkable how far-out ideas get publicity and support **with a little help from us** 😞😊

Physics is difficult, and therefore boring

Physicists from different schools don't agree ...

<http://www.quantumconsciousness.org/penrose-hameroff/quantumcomputation.html>

A typical inductive ☺ argument (Hameroff):

"In this century the **classical computer** has been the dominant metaphor for the brain's activities."

"If quantum computation becomes a technological reality, **consciousness may inevitably be seen as some form of quantum computation.**

Indeed enigmatic features of consciousness have already led to proposals for quantum computation in the brain."

Penrose/Hameroff proposal:

Protein assemblies called microtubules
within the brain's neurons are viewed as

self-organizing quantum computers

"orchestrated objective reduction - Orch OR".

Penrose and Hameroff, 1995; Hameroff and
Penrose 1996a; 1996b; c.f. Hameroff 1997;
1998a; 1998b; 1998c; 1998d).

The problem is of course(?) that we do NOT have any "physical" model for (self) consciousness and the process of thinking.

And, on top of that, we just have fragmentary knowledge of how the brain works.

- To ascribe brain functionality, and in particular mind and consciousness, to quantum phenomena is premature, not constructive, and most probably wrong.
- Alchemy of the mind
- Quasi-religion
- Mystifies the issue of "free will" to invoke QM (?)

Quantum biology on the edge of quantum chaos

Gabor Vattay, Stuart Kauman and Samuli Niiranen

arXiv:1202.6433v1, 29 Feb 2012

Localized (power ser) - extended states (exp decay)

“Then, in principle, quantum degrees of freedom, including biomolecules, can “hover” between open quantum behavior and classicality FAPP”

→ **“The Poised Realm”** between

- fully coherent quantum behavior in open quantum systems and classicality FAPP
- deterministic and non-deterministic behaviour

“**Recoherence**, including to a new superposition state, is possible for open quantum systems.

- i. Several papers by Paz et. al., and **Briegel**, show that a quantum entangled state can **decohere to classicality** (GW ??????????) **FAPP** and **recohere** again.
- ii. Imposition of a classical field can induce recoherence.
- iii. The Shor quantum error correction theorem, proves that if in a quantum computer some qubits are partially decoherent, measurement can be done and information injected, correcting the qubits back to full coherence.”

"The definite behavior of a Turing machine is the definition of algorithmic behavior.

A major **contemporary** view in neuroscience and computer science and much of the philosophy of mind is that the **mind-brain system must be algorithmic** - some huge system of interconnected logic gates or, more broadly, continuous time and state classical physics neurons firing."

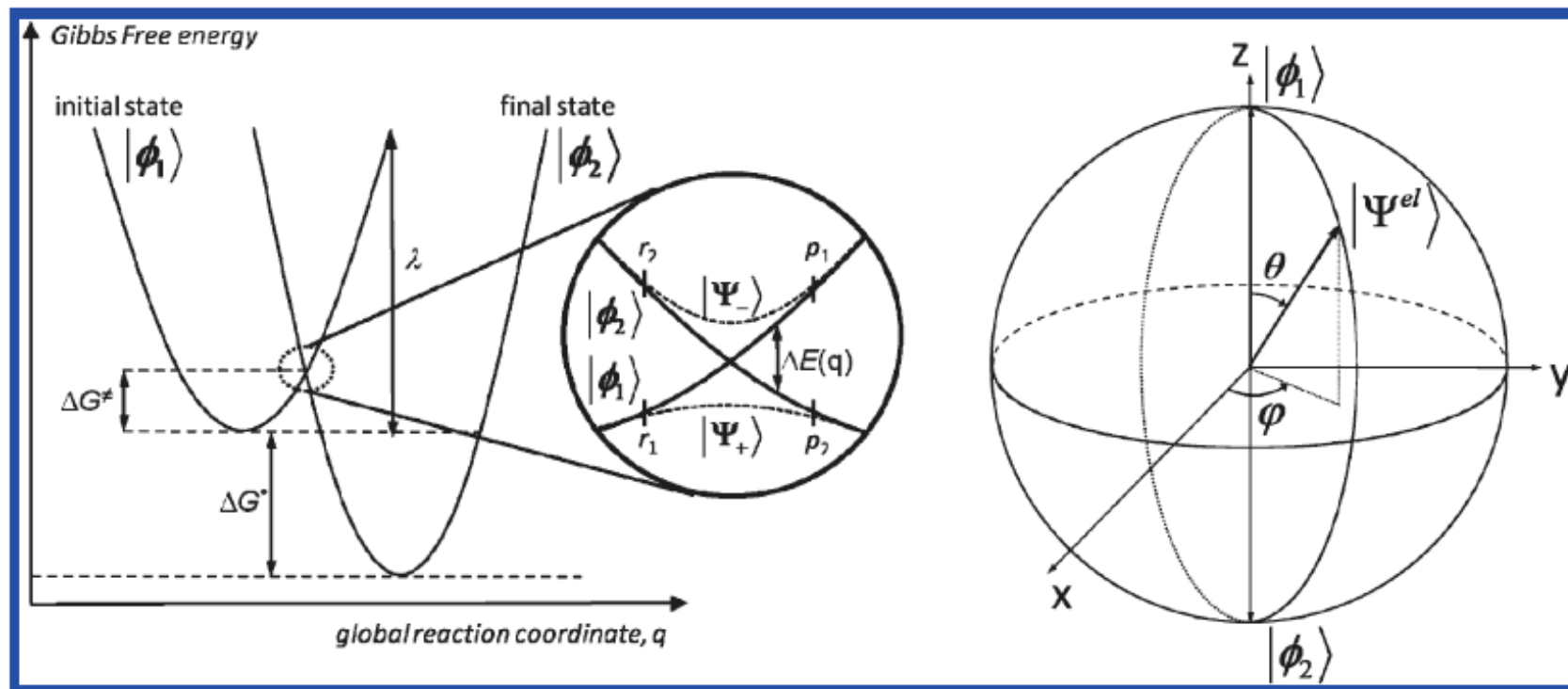
Contemporary, really ???

Anyway, hardly true

A Trans-Turing System, TTS, "lives in" the Poised Realm, and perhaps involves **quantum measurement** in the Poised Realm.

There are quantum degrees of freedom propagating in short lived superposition states that decay rapidly due to decoherence. But **these short lived superposition states** undergo constructive and destructive interference and **will be one basis for a non-determinacy** in the Trans-Turing system when coupled via decoherence to classicality for all practical purposes, FAPP, or quantum measurement. **Thus TTS are not algorithmic, not determinate and not state determined**, in contrast to a Turing Machine.

"A part of a TTS has been realized in a computation by D. Salahub, a quantum chemist at U Calgary and colleagues."



But this is nothing but a standard QM description of a 2-level situation at the transition point involving superposition and entanglement ... !

Final Kauffman quotation:

"Ideas resting on open quantum systems lead to new and testable hypotheses in molecular, cellular, and neurobiology, and, hopefully, a new line of ideas in the philosophy of mind including proposals about:

- how mind acts acausally on brain
- an ontologically responsible free will
- what consciousness IS
- the experimentally testable **loci of qualia** as associated with (entangling; GW comm) quantum measurement itself
- the irreducibility of both qualia and quantum measurement
- **long-distance entanglement** underlying the "Unity of consciousness", i.e. the "**qualia binding problem**" and its cognate "**frame problem**" in computer science"

After my own talk, having noted and studied Hans Briegel's earlier talk in the workshop, it seems to me that the "Projective Simulation" model looks like a natural framework for a biological (or artificial) system to be able to deviate, or to be free, from deterministic behaviour.

Consequently, there is no reason, even at the classical physics level, for the brain to be algorithmic, and the associated mind to be deterministic.

Which means that quantum physics has no fundamental needed role in the mind-brain problem, and Kauffman's piecing together of quantum physics elements is neither warranted nor needed.

End of Story
- Thanks for the attention