Editorial

Is a New Physics Necessary?

NeuroQuantology: closing the great divide

Sultan TARLACI

Editor-in-Chief, NeuroQuantology

"It would be most satisfactory if *physics* and *psyche* could be seen as complementary aspects of the same reality".
Pauli 1952

"...the impossibility in psychical (i.e. psychological) experience to distinguish between the phenomena themselves and their conscious perception clearly demands a renunciation of a simple causal description on the models of classical physics, and the very way in which words like "thoughts" and "feelings" are used to describe such experience reminds one most suggestively of the complementarity encountered in atomic physics."
Bohr, 1958

As we enter the next millennium, neuroscience and quantum physics are trying to define their future roles. We trace the emergence of neuroscience over last two decades that has informed both disciplines. The ambivalent relationship between neuroscience and quantum physics is also reflected in the history of training requirements for both fields. Recent advances in neuroscience that have compelled paradigmatic shifts within both disciplines include further understanding of the inseparability of the mind and brain.

Modern neuroscience has confirmed that organisms are the product of the interaction between genes and environment. All mental processes are ultimately biological. Any alteration of these processes requires an organic process. Molecular biology now offers the most profound insights and possibilities regarding human mental activity. The historic debates about mind versus brain, nurture versus nature, and functional versus organic should be abandoned.

Neuroscience cud physics continue to offer new insights into many complex phenomena such as perception, remote effects, mind-body interactions, puzzle of consciousness experience, memory, neural computation, gamma oscillation, global workspace and brain, nonlocality, chaos and brain etc. Profound and unprecedented developments in neuroscience represent the leading edge of biomedical research, if

not all science. It now has access to objective methods for testing specific hypotheses about how the mind works. Neuroscience must expand its horizons to include the study and research of physics. Widespread collaborations involving physics, neuroscience, philosophy, cognitive neuroscience and other disciplines can now be focus on the three central research questions:
1.How do biologic processes of the brain give rise to mental events?
2.Is there a relationship between brain and quantum physics?
3.What is the role of the brain in the universe? (or universe in the brain?)

NeuroQuantology: new physics

Especially during the second half of this century, physics has made important contributions in order to explain significant aspect of the functioning of the brain. If we want to study the physical aspect of a brain, classical physics probably would not be appropriate because in general a classical description is based on the decomposition of a system in a collection of simple elements which are independent and local. Quantum theory is a wonderful elegant theory, which at least in principle, allow us to calculate the properties of all physical and chemical systems. It is accurate and universal, and no violations of its predictions are known, even where those predictions are very counter-intuitive.

The idea that consciousness has to be introduced in order to understand quantum theory has been around since the 1920's. It is interesting to note that quantum mechanics was linked to living systems and thought, and hence to brain science, in an early paper by Haldane (1934) which aroused the interest of Wiener (1934), as related by Masani (1990). Consciousness is not referred to as such in these papers, but is implicitly acknowledged in references to *perception* and *ideas* and *universals*. The main argument is that the mind-body problem, or the relationship between mind and matter, has to be seen differently in the light of quantum mechanics, because the latter shows matter to have properties that were previously considered to be peculiar to minds.

Quantum physics assigns an essential role to the observer of an event or experiment. The relation quantum event-observer may lead us to think that quantum physics will explain consciousness. The early book of von Neumann (1955) is frequently quoted in support of an interpretation of quantum mechanics, according to which particles exist purely as probability-density distributions (in accordance with the Schrödinger wave equation) until they are forced to assume definite locations by the action of an observer. Recent contributions are due to Jibu and Yasue, Pribram, Lockwood, Mavramatos and Nanopoulous, Hameroff and Penrose, and Stapp. These authors have models in which the operation of consciousness is associated with some sort of explicit wave function collapse. There have been numerous suggestions that consciousness is a macroquantum effect, involving superconductivity, superfluidity, electromagnetic field, Bose-Einstein condensation or some other mechanism. Perhaps the most concrete one is that of Penrose&Hameroff, proposing that this takes place in microtubules. It has been argued that microtubules can process information like a cellular automaton, and Penrose suggest that they operate as a quantum computer.

Where there is a fundamental property, there are fundamental laws. In this case,

the laws must relate experience to elements of physical theory. If we find a theory that fits the data better than any other theory of equal simplicity, we will have good reason to accept it.

Of course, such ideas may be all wrong. On the other hand, they might evolve into a more powerful proposal that predict the precise structure of our conscious experience from physical process in our brains. If this project succeeds, we will have good reason to accept the theory. If it fails, other avenues will be pursued, and alternative fundamental theories may be developed. In this way, we may one day resolve the greatest mystery of the mind and our brain.

The goal of physics is a “theory of everything” from which all there is to know about the universe can be derived. If the existence of consciousness cannot be derived from physical laws, a theory of physics in not a true theory of everything. We believe that facing another turn of a century, we will see fundamental changes in the neuroscience and quantum physics.

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