

Max Planck and later Albert Einstein, founding fathers of Quantum Phenomenon were uncomfortable after their discoveries and explanations. Einstein's discomfort grew as Quantum mechanics progressed and he could not reconcile to what he called 'incomplete description of world'. After all what Planck started as a discontinuous distribution of energy soon became a packet of energy called quanta and expanded to light and other radiation. Neils Bohr took it deep into atoms and explained the orbits of electron as quantized.

The debate between Neils Bohr and Einstein continued till their lifetime and signified the agony of a break from the determined Newtonian world with absolute time-space and cause-effect. The brain was trained to perceive the world in Newtonian frame. Einstein himself had destroyed the absolutism through relativity. The continuous flow of reality was fragmented to a discontinuous, granulated reality at a microlevel, at higher speeds time became relative and entwined with space, even gravity was not spared. Boltzmann's entropy created disorder. Nothing was stable and predictable anymore. Whatever semblance of order remained was destroyed by wave-particle duality and Heisenberg's uncertainty principle. Physicist grappling with newfound reality in first quarter of last century, were divided and they still are even after experimental proof. Mathematics of quantum has proven to be effective yet the true understanding or the visualizability of quantum world still eludes. For it is counterintuitive and beyond the range of human senses. Copenhagen interpretation of Quantum was the most widely accepted explanation. Many world interpretation and relational QM provide alternative, but they are explanations at best. Quantum entanglement has been proven experimentally and forms the basis of quantum computing and quantum phenomenon has been found in a variety of systems - from photosynthesis, bird's aviation and particle physics. The world of very small is quantum. The probability, uncertainty and the discontinuous are the basis while observer-based reality challenges the objective world that exists without anyone looking at it, something that Einstein struggled to prove.

But human brain does not realize this. The brain has the need for survival, genetically pushed to reproduce and continue species, whether for some meaning or otherwise is a matter of debate. The brain has evolved to be a predictive machine based on memory arising out of perception and information processing. A continual interface with external makes it a semi-closed system with predominant unconscious processes and a frame of reality in few hundred milliseconds reaching consciousness. The time frame is in milliseconds. Is it quantum? Though theories like ORCH-OR by Roger Penrose and Stuart Hameroff try to explain consciousness at the level of microtubules in neurons it does not explain human cognition and activities at large. The wet noisy brain with million processes 'decoheres' faster in interaction with signals. The processes of the brain that we measure are in milli- to seconds while quantum processes reside at smaller temporal scales. Where does the quantum to classical happen in brain and what is an observer in brain? Will or intent or information, externally generated via senses or internally generated.

Are the conscious frames of reality, thoughts? Envelopes with words as symbols. The frames are discrete but due to short time gaps appear continuous. The quantum discontinuity exists at the level of thoughts.

Reviewing the process of brain may be worthwhile

All life is embedded in space-time (4 or more dimensions) and 4 fundamental forces.

The Brains of all species perceive space- time from within or without but categorize it into cycles or a clock like humans. All energy carries information to brain through senses and all signals are converted to electro-chemical activity in a network of 1011 Neurons making 1014 connections.

Genetics directs the vector of life.

The initial condition of zygote formation and boundary condition of death is universal.

Universal Macroscopic laws encompass Mesoscopic laws (as on Earth) and microscopic processes of the subatomic world exist in the brain and body too, interfacing at all three intertwined levels.

At a gross level, three realities exist - Cosmic (M1) - the structure of Universe-single or multiple. Classical laws (M2) - perceived as reality by sentient beings, however incorrect, still maintaining the world of our forefathers-deterministic, theoretically reversible in a cause-effect relationship (not in keeping entropy of closed systems.). Nonlinearity and chaos create unpredictability here too. Quantum (M3) - Microscopic world of probability,

indeterministic, irreversible, observer-dependent (measurement) -something that Einstein could not accept even though he triggered this movement.

M3 and M1 interact at all levels from electrons, wave particle duality, uncertainty of measurement, to deterministic (Schrodinger's wave equation), entanglement, space time curvature, special and general relativity, all within a light cone, forming a flow of past, present and future. Whether it is linear single history or multiple histories is a matter of measurement (similar thoughts have been elucidated in ancient Indian Philosophy). Possible decoherence at a larger scale of time and space creates a reality in M2 to further enhance dimensions and scales of reality in an inhabitable world.

The brain processes cannot have a separate way of functioning as measurement tools have been able to detect /subtract areas and signalling, bordering on M2 to M3 (Bohr's debate about measurement tools being classical even if we are measuring quantum)

To understand it better let us assume that the brain functions at 3 levels - X, Y and Z. where X - conscious Y - Intermediate. Z - out of conscious Movement of any thought from Z to X is approx. 200-500 ms hence 500 ms timeline 10 milliseconds (it is never zero because initial conditions go back to intrauterine life for a given brain). Let us assume the initial point as NOW but brain does not start activity now, it is already under the firing potential from memory and has a history, also the environmental conditions ranging from temperature to biological needs, and external stimuli modulate it even if we reject desire, will and other tricks of mind. Multiple frames of reality exist at this instance and all instances (created by electrochemical activity in all brain areas). The vague free-floating images, thoughts, emotions move like a cloud, even at rest the self exists, and is bound by oscillation and binding current (cerebral cortex perceiving or watching this cloud emerging from deeper motor or limbic areas.

Assume it to be a system in Quantum state - the thoughts, emotions emerging out of a continuous decoherence and repetitive cycle yet in a new state. The vector, phase space and probability is directed to create an attractor dimension presented as an 'I'. 'NO' action at an instance of resting state is followed by, the higher center deciding to act and insert 'will' or 'intent', the free floating quantum vectors start coalescing towards the desired dimension. Under the observation of will as an observer (free or conditioned). Certain degree of freedom (df) exists at t.

If the desired phase space is attained the system returns to another cycle ($t + n$) but if it goes to strange attractors and a different phase evolves (depending on discrepancy between will and results) the gap feeds back the higher centres and Will 2 is asserted again. The df at t_1 is one degree or many degrees less depending on changed external conditions added by limbic activation (predictability vs. unpredictability). The process is still out of conscious sphere except when Will 1 reads the gap and decides on Will 2, the central Centres read the meaning in the feedback gap, either reason out a cause and effect with a corrected instruction set to w or the deeper structures like amygdala increase their firing to express their phase spaces by reading the gap as frustration in the copy relayed to them.

Each attempt builds up a further activation of limbic structures perceived as emotions, as word and thoughts fail to contain them -anger, lust and other so called negative or positive emotions fill the phase space of the conscious mind, without any control by higher inhibitory centres. 13. The process is quantum at rest, with high and pluripotent probability clouds, with intent Or will as an observer. (i) the deeper neuronal firing moves to decoherence. (ii) the process switches nonlinear or deterministic chaotic dimensions to decide the future. (iii) the feedback loops to cortex and limbic areas activate them to judge the threat or satiety of this dynamics to choose further action (iv) Central executive networks, Default mode networks, Salience network of brain determine it. (v) This linkage may sound fantastic and amusing and may be difficult to prove mathematically and more so experimentally but the real problem of catching the mind is even more. (vi) The reductionist approach may stop at measuring and observing the NCC and write the epitaph that 'Mind is an emergent property of Brain' but the crux remains 'how does the final step happen' and the question of subjectivity' (Bohr and Einstein differed on this). Science does not like subjective so change it to 'uniqueness of perception' but beyond the gross features of perception, cognitive assimilation and affective load differs in each brain. Is this the mind?

Broadly at a resting state the world is represented in neuronal ensembles as superimposed probability state,

external or internal sensory signal generated by need, stimuli, thought decoheres these states. The system enters a nonlinear process towards a deterministic chaos towards the self (i.e. formed of memory as firing patterns) and reaches conscious brain and decision-making centre in 300-500 ms. The higher centres place these probability states in social meaning and decide the action in a Bayesian mode. The best action is chosen as the best probability to anticipate the next moment. All actions generate feedback that is received through senses and another cycle starts.

Indeed, these cycles themselves are just electrochemical activity, but human brain has to generate meaning, each such cycle is an envelope called thought - a discrete quanta that is made of need, emotion, images labelled by words. Language and motor action represent a vector that represents movement.

This vector is analogous to quantum process - superimposed internal probability states in neurons, decohering under stimulus that provides classical interface, the observer is will or intent or a sensation. The system enters a classical nonlinear dynamics with entropy rising at each emergent level till a limit cycle is reached. A new set of probability states is represented to higher centres in 300-500 millisecond and a decision is made.

Brain thus involves various physical principles and processes, the meaning emerging as a cause effect. Most of these are counterintuitive and beyond the range of senses. Scaled up in scale and time brain is analogous to Quantum discontinuity and probability. The ultimate purpose of brain and cognition, imagination and thought is to reduce ambiguity and create a sense of certainty in a world that is uncertain and random. While Heisenberg's uncertainty and Schrodinger's cat may exist in microscopic world and as the basis of matter and life (DNA and molecules), human brain applies it to the causal world to find determinism.

Relational quantum mechanics explains the emergence of subjectivity as the states are always relative to the observers- as a theory about the description of physical systems relative to other systems in a complete description of the world.

This is dangerously close to Buddhist concept of Shunyata(emptiness), Insubstantiality that says nothing is of any substance on its own but rather of dependent origination. It is the mind that gives a substance.

Buddha may have said it without knowing quantum physics