

CONSCIOUSNES

Scientific Problem of Consciousness

Consciousness \equiv Mind in the West

External World

Internal World

- Matter
- Radiation Force
- OTHER LIVING CREATURES
- Concepts

↓
Space
time
Causality
Force

Particle
Wave
Spin

- Conservation laws
- Principles
 - Least Action
 - Pauli's Exclusion
 - Heisenberg's Uncertainty
- Mathematics.

Cognition
Memory
Motor Action
Mathematics

Thoughts
Emotions
Feelings
Intuitions

Hallucinations
Dreams.
Sleep.

Mathematics.

Brain is the
Bridge Between
the two

Are Brain Processes Quantum Mechanical?

- The penetration of a neurotransmitter through a synaptic vesicle -

mass $\approx 10^{-17}$ gms.

$d =$ barrier thickness $\approx 10^{-6}$ cms.

$v = 10^{-2}$ cm/sec.

} These parameters which are realistic do provide 'marginal evidence' for possibility of Quantum Tunneling.

- Eccles in a very recent paper in Proceedings of the National Academy of Sciences (1992) points out the following instance:

Radio Xenon Mapping and PET techniques show increased blood flow in a localized region of the Neocortex when the person under observation is demanded to generate words.

This increased blood flow is attributed to a process exocytosis - a presynaptic impulse propagating into a bouton and causing an influx of Ca^{2+} ions. However this exocytosis is not generated on every occasion, but with probability of 1 in 3, 1 in 4 and never more than 1 exocytosis. Eccles and Beek attribute this

controlling effect to the vesicles being embedded in a paracrystalline presynaptic vesicular grid that is subject to quantum physics.

7. Behaviours of Particles in Assemblies.

Fermi-Dirac
Bose-Einstein } Statistical Distributions
depend on the
Spin parameter of
individual particles.

Macroscopic Effects depend on
Quantum parameters - integral or
half-integral Spin.

LASERS.
Superconductivity. }

COHERENCE

DOWNWARD CAUSATION.

Big Bang Cosmology :

Transcendence in Physics and its implications to Consciousness.

- Traditional Role of Physics :
- Provide Fundamental explanations to all natural phenomena essentially in the inanimate world.
- Physics (i) NEWTON TO MAXWELL
(ii) MAXWELL TO PLANCK, Einstein and Dirac — Present Day

• Newton to Maxwell

• Phenomena
↓

- properties of matter.
- Heat,
- Light
- Electricity
- Magnetism
- Sound
- Gravitation.

Concepts

- Space,
- time,
- mass
- particle
- Wave
- motion
- Vibration
- Force
- Energy
- Statistical }
behaviour }
- Electric charge
- Magnetic Dipole
- FIELD !!

• ALL CONCEPTS DRAWN FROM
Everyday Experience, and
Common Sense.

Additional Principles

- Pauli's Exclusion Principle.
- Heisenberg's Principle of Uncertainty

What is most important to recognise is that at all levels, the processes of nature are not just random. The processes are regulated by Nature's Laws and Principles. Even the violations of the laws are constrained by some principles.

What is the relevance of the Transcendence in physics to Consciousness?

According to current ideas of science:

Consciousness is a result of (or is correlated to) neuronal activities.

Neuronal activities: (i) Biochemical processes
+
(ii) physico-electro-chemical processes.

No new constituents }
No new forces }

∴ Reduces to another form of physical activity

∴ Some happenings in the Quantum vacuum.

In the first instance it may appear trivial.
It is not so.

By attributing Consciousness to some kind of activity in the all pervasive vacuum, we have removed some of the most vexing problems

- (i) The observer, the observation, the observed
(All are different manifestations of the same Substratum)
- (ii) The Mind Body Problem
- (iii) The Binding Problem.

These are resolved in the same sense as

- (i) the action at a distance problem of all forces - Gravitation, EM, Nuclear.
- (ii) penetration through the barrier - in radioactivity, Spontaneous decay

In as much the differences in the properties of fatty acids, sugars and alcohols, all made of the same elements (C, N, and O) have to be traced to differences in their spatio-temporal structures at the deeper levels of the constituents - which are brought about by the EM forces - which again are happenings in the vacuum →

(7)

Cognitions, thoughts, emotions ... all reduce
to the formations and interactions of
corresponding structures of the vacuum.
These could be at the multimolecular
levels or at much deeper levels.

TABLE 2.1

Properties of elementary particles discovered in Cosmic Rays 1930-1955.
 (Some of the properties listed - spin, life time, anti-particle, decay modes were determined later in accelerator experiments)

Name of Particle	Symbol	Strange no	Anti Particle Symbol	Anti Particle Charge no	Mass in terms of m_e	Spin	Charge	Life time in seconds	Decay Modes
Positron	e^+	0	e^-	0	1	$1/2$	1	-	-
Muon	μ^-	0	μ^+	0	207	$1/2$	1	2.2×10^{-6}	$(e^- \nu_\mu \nu_e)$
Pion	π^-	0	π^+	0	273	0	-1	2.6×10^{-8}	$(\mu^- \nu_\mu)$
	π^0	0	π^0	0	264	0	0	8.0×10^{-17}	$(\gamma\gamma)$
Kaon	K^+	+1	K^-	-1	966	0	+1	1.2×10^{-8}	$(\pi^+\pi^0), (\mu^+\nu_\mu), (e^+\pi^0\nu_e)$
	K^0	+1	\bar{K}^0	-1	974	0	0	$k_S: 9 \times 10^{-11}$ $k_L: 5.4 \times 10^{-8}$	$(\pi^+\pi^-), (\pi^0\pi^0)$ $(\pi^0\pi^0\pi^0), (\pi^0\pi^+\pi^-), (\pi^-e^+\nu_e)$
Lambda Hyperon	Λ^0	-1	$\bar{\Lambda}^0$	+1	2183	$1/2$	0	2.5×10^{-10}	$(p\pi^-), (n\pi^0)$
Sigma Hyperon	Σ^+	-1	$\bar{\Sigma}^+$	+1	2328	$1/2$	+1	8.0×10^{-11}	$(p\pi^0), (n\pi^+)$
	Σ^0	-1	$\bar{\Sigma}^0$	+1	2334	$1/2$	0	10^{-14}	$(\Lambda^0\gamma)$
	Σ^-	-1	$\bar{\Sigma}^-$	+1	2343	$1/2$	-1	1.5×10^{-10}	$(n\pi^-)$
Cascade Hyperon	Ξ^0	-2	$\bar{\Xi}^0$	+2	2573	$1/2$	0	3.0×10^{-10}	$(\Lambda^0\pi^0)$
	Ξ^-	-2	$\bar{\Xi}^-$	+2	2586	$1/2$	-1	1.7×10^{-10}	$(\Lambda^0\pi^-)$

Quantum Mechanics and Consciousness

Historically the connection between QM and Consciousness came in a peculiar way:

The solutions to the Schrödinger Equation could give only probabilities - not a definite prediction regarding the result of an observation.

There was need somehow to "collapse" the wave function. Mathematically or physically there was no way.

The collapse had to be non-quantum mechanical according to Neumann and he put forward the idea that it is the observer's consciousness that can do the job. Whether the observer should be capable of figuring out a "meaning" for the observation.

Many alternative proposals are there - Many Universes, Environmental Decoherence etc.....

Bohr, Heisenberg: We can only talk about our EXPERIENCE of the world - Not world per se

"In our description of Nature, the purpose is not to disclose the real essence of the phenomena, but only to track down as far as possible relations between the multifold aspects of our experience"
Bohr.

"Physics is an attempt conceptually to grasp reality as it is thought independently of its being observed."
Einstein.

Features of Quantum Mechanics

- Probabilistic Interpretation. - only Probability Waves
- wave/particle duality.
- Superposed States
- Collapse of the wave function. - by consciousness?
- Non-Locality - ONENESS
- Statistical Determinism -
- inherent Uncertainty - Heisenberg's principle.
But limits defined
- Quantum Coherence - Bose-Einstein Condensate
(established in the lab)
- Spontaneous Creation
- Picturisation is NOT FEASIBLE.

- Non-Local Effect in Biology. an example.

Proteins are long chains which must contort to very complicated and specific shape before they can do their specific job. How does this happen?

Most stable state, minimum energy etc.

For optimum configuration, widely separated portions of proteins have to move in unison. - Otherwise the molecule would be tangled. -

Plethora of non-local quantum activity?

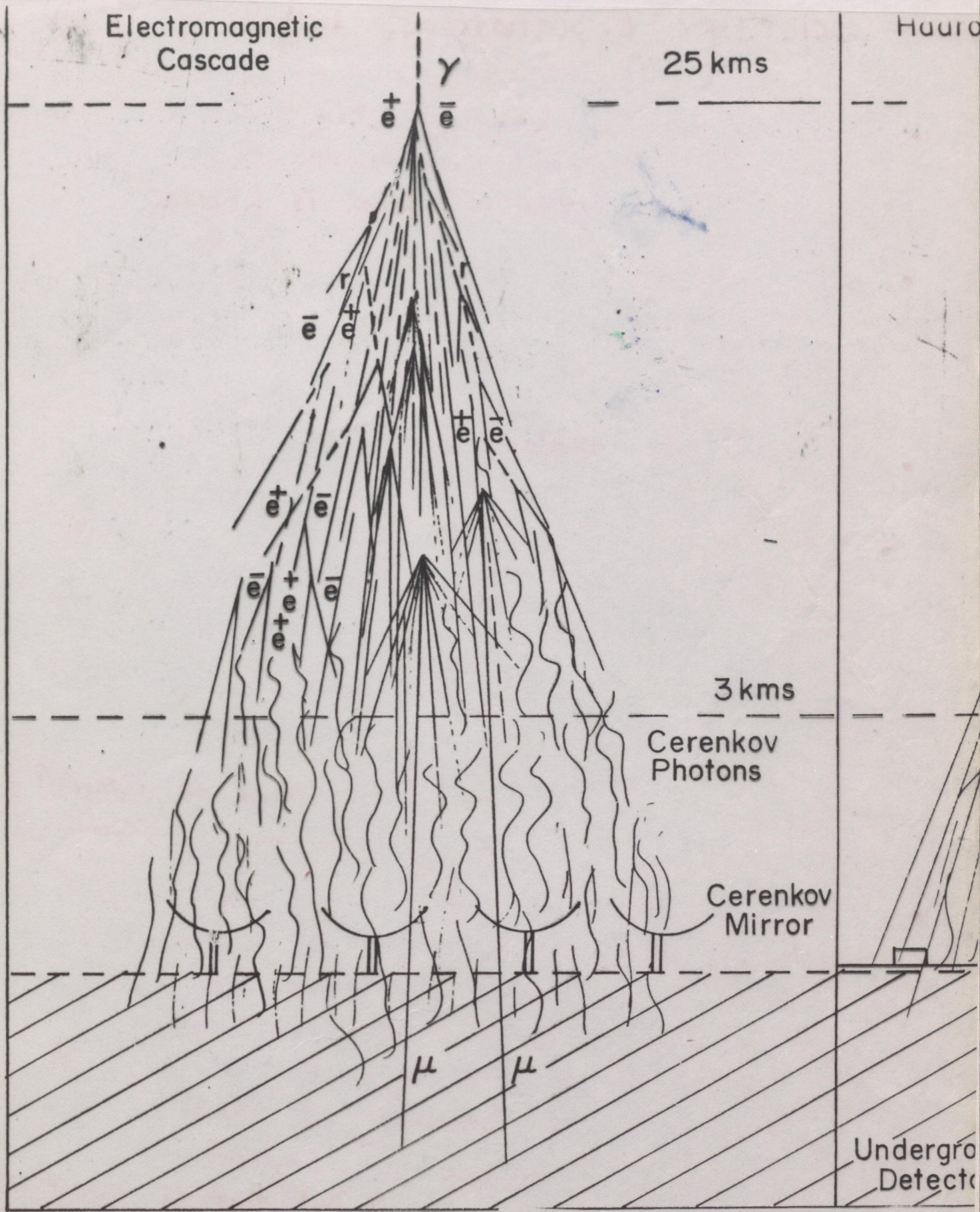
Quantum Physics and Consciousness

1. What is Consciousness?
2. What is the Connection between Physics and Consciousness.
3. Why Quantum physics.?
4. Quantum Vacuum and Consciousness.
5. Emergence and downward Causation - Physics examples.

- All Phenomena in Nature - physical or mental involve energy transaction - absorption or emission
 - Max Planck: Energy exchange can only be in discrete units (not continuous) (Epistemological)
 - Einstein: Energy exists only in the form of discrete quanta. (ontological)
- ∴ All phenomena in Nature are quantum mechanical
But - sometimes you can ignore QM nature

Qualia of Redness

- Redness is a specific frequency of EM spectrum.
- The theory of quantum coherence in the cytoskeleton implies excitations of a ground state yielding a condensed field of coherent bosons (phonons, photons, etc.) with specific frequency characteristics. Red of the EM spectrum can then correlate with a specific frequency of boson-field excitation in the brain.
- If true and when technologically possible, the frequency of the boson field excitations corresponding to red in two people can be compared.
- More complex qualia (e.g., love, pepperoni pizza, etc) can then be viewed as complex mixtures of coherent boson fields, which as macroscopic quantum states may also have suitable properties for a unitary sense of self.
- [Quantum boson fields are unitary, though non-local states. They can exist in superposition of many states collapsing into a single one. To which state a superposed quantum state collapses can be seemingly random and non-deterministic. Thus macroscopic quantum states, unlike neuronal firing level correlates can have non-deterministic properties → FREE Will?



Development of an Extensive Air Shower in the atmosphere due to the incidence of a very High Energy (>TeV) Gamma Ray photon

Scientific Explanations.

- ALL Explanations whether Scientific or otherwise have to be to serve any purpose in terms of what is known.
 - C.V. Raman: "You seem to be an expert in explaining one unknown in terms of another unknown"
 - In Science explanation depends on
 - (i) the level at which explanation is sought and understood
(School boy, Common man)
 - (ii) the purpose for which it is sought -
(Contextual dependence)
 - (iii) Ultimate or most fundamental explanation - [Limitations of Science?]
 - While in terms of achievements, technological benefits etc, there is no hierarchy in Science, in terms of explanations, especially as we move towards fundamental explanations (characterized by knowledge for the sake of knowledge) a hierarchy is inevitable
 - Life Sciences depend on Physical Sciences
 - Biology on Chemistry
 - Chemistry on Physics
 - Physics on elementary particles and forces (QM)
 - (Matter, Radiation) - Particles - Quantum vacuum
- But there is the important aspect of mutual dependence - the role of the observer -