# 2 renowned physicists on the controversial theory of consciousness (with video)

## Sir Roger Penrose and Stuart Hameroff discuss how the discovery of quantum vibrations in 'microtubules' corroborates the theory of consciousness

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A review article on the controversial theory of consciousness, published recently in the journal *Physics of Life Reviews,* claims that consciousness stems from deeper level – from finer-scale activities inside brain neurons.

"Consciousness in the universe: A review of the 'Orch OR' theory" was written by Dr. Stuart Hameroff, MD, Emeritus Professor and Director of theCenter for Consciousness Studies at the University of Arizona, and Sir Roger Penrose, Professor of Mathematics at the University of Oxford, a Fellow of the Royal Society in the UK, and a Nobel Prize candidate in Physics in 2008.

# Read the article

"Consciousness in the universe: A review of the 'Orch OR' theory," by Stuart Hameroff, MD, and Roger Penrose, PhD, in *Physics of Life Reviews,* is freely available online on ScienceDirect.

Working together, they proposed the theory of Orchestrated Objective Reduction, popularly known as Orch-OR, one among many existing models of consciousness, in the late 1980s. Their proposal deals with quantum computing in the brain due to gravity. Prior to that, in 1982, Dr. Hameroff had devised the theory that microtubules in the brain hold memories.

The recent discovery of quantum vibrations in "microtubules" inside brain neurons corroborates this theory, according to Dr. Hameroff and Dr. Penrose. They suggest that EEG rhythms (brain waves) also derive from deeper level microtubule vibrations, and that from a practical standpoint, treating brain microtubule vibrations could benefit a host of mental, neurological and cognitive conditions.

Another aspect of the theory that has been introduced with the discovery of the quantum vibrations is that they appear to interfere and produce slower EEG frequencies. Despite being used in medicine for 100 years, the underlying origins of EEG rhythms have remained a mystery.

Prior to an event in Amsterdam on the subject, we met  Dr. Penrose and Dr. Hameroff to talk about the implications of the recent discovery of quantum vibrations on human consciousness.

This is a video of our interview with them, followed by a summary of their responses.

# Watch the video

# Q&A: Highlights of the interview

## How does your theory of consciousness differ from other theories?

- **Penrose:** Other theories consider consciousness to be due to complex computation among brain neurons. We think consciousness and understanding are not really just computation, but require something else, some type of quantum physical process intrinsic to the universe.

- **Hameroff:** Biologically, these quantum processes occur at a deeper level, smaller, faster scale inside brain neurons, in protein structures called microtubules which seem to be natural quantum resonators, and can store and process memory and information.

## Can you summarize the ORCH OR theory underlying your research?

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**Penrose:** OR is *objective reduction*, the mechanism I proposed for consciousness due to quantum state reduction connected to the fine scale structure of the universe — spacetime geometry.

- **Hameroff:** Orch is orchestration, the means by which quantum processes in microtubules can be programmed and connected to membrane and synaptic-level events.

## What are the possible implications for us/for humankind?

- **Hameroff:** Quantum processes imply non-locality — conscious connections when physically separated. And Roger proposed that Platonic values embedded in the universe influence our conscious perceptions and choices. We are part of the universe. In my opinion, this has possible implications for spirituality.

## How did you come to those findings?

- **Penrose:** In my 1989 book 'The emperor's new mind' I described the need for quantum mechanisms in the brain to account for consciousness and understanding.

- **Hameroff:** I had been studying information processing in microtubules, but lacked a mechanism for consciousness. Then i read Roger's book and thought microtubules were the structures he needed. We teamed up to develop a formal theory.

## It seems that after 20 years, the findings of your research have been validated? Can you tell us about these new insights?

- **Hameroff:** For many years critics said the brain was too 'warm, wet and noisy' for delicate quantum processes, but now we know plants use warm quantum coherence in photosynthesis, birds use it for navigation, and our sense of smell depends on quantum processes. Most importantly, Anirban Bandyopadhyay discovered warm temperature quantum resonances in brain microtubules, proving the plausibility of our proposal. The resonances occur across many scales, and can interfere to give slower vibrations seen as the EEG, or brain waves. EEG has been used for a century but its underlying origin has remained mysterious. We think EEG brain waves originate in a deeper level inside neurons, due to quantum vibrations in microtubules.

## Any other areas you want to touch upon that are close to your heart? For example, what is your motivation behind this research? It seems there is renewed interest behind these questions — consciousness and how this can be explained from a physical point of view. Is this true? Is there a new perception in your research? And if yes, how has the perception changed?

- **Hameroff:** Classical science sees neuronal firings and synaptic connections as basic bits, or information states in the brain. And billions of dollars are going to mapping all these connections in the hope to capture the essential feature of brain function - consciousness. This brain mapping may be missing the point entirely. We should be mapping deeper levels of scale, into the quantum vibrations in microtubules and other biomolecules. And therapeutically, stimulating microtubule resonances, for example with ultrasound megahertz vibrations, appears clinically useful in psychiatric, neurological and cognitive disorders. For example, in Alzheimer's disease, brain neuronal microtubules fall apart,'and brain ultrasound may put them back together.