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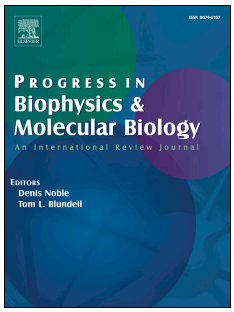

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The quantum physics of synaptic communication via the SNARE protein complex

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Abstract

Twenty five years ago, Sir John Carew Eccles together with Friedrich Beck proposed a quantum mechanical model of neurotransmitter release at synapses in the human cerebral cortex. The model endorsed causal influence of human consciousness upon the functioning of synapses in the brain through quantum tunneling of unidentified quasiparticles that trigger the exocytosis of synaptic vesicles, thereby initiating the transmission of information from the presynaptic towards the postsynaptic neuron. Here, we provide a molecular upgrade of the Beck and Eccles model by identifying the quantum quasiparticles as Davydov solitons that twist the protein α-helices and trigger exocytosis of synaptic vesicles through helical zipping of the SNARE protein complex. We also calculate the observable probabilities for exocytosis based on the mass of this quasiparticle, along with the characteristics of the potential energy barrier through which tunneling is necessary. We further review the current experimental evidence in support of this novel bio-molecular model as presented.

Keywords: Davydov soliton; exocytosis; quantum tunneling; SNARE proteins; volatile anesthesia