Quantum Origins of Magnetic Sensing

Initiative: Lichtenberg - Professuren

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Key biological processes involve conversion of energy into forms usable for chemical transformations or cellular signaling. This conversion often involves electronic degrees of freedom and occurs through chemical reaction, light absorption, excitation energy transfer, and electron or proton transfer. A particularly striking example of a possible quantum mechanical process is magnetoreception, which assists navigation in animals, for example in migratory birds. But how does a migratory bird find its way with a precision unobtainable by human navigators before the emergence of GPS? The cellular, molecular and biophysical basis of this enigmatic sense remains an unsolved scientific mystery. The research of the professorship is focused on studying the mechanisms of magnetic sensing from the physics point of view. The fundamental biophysical hypothesis of magnetoreception suggests that the avian magnetic compass sense is a quantum process, that originates from cryptochrome photoreceptor proteins and their interaction with the geomagnetic field, enabled through quantum mechanics and radical spin chemistry. By employing state-of-the-art techniques of computational microscopy the photobiology of selected avian cryptochromes will be studied. The aim is to predict whether these proteins are capable of magnetic field sensing.

Projektbeteiligte

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VIKING: A Novel Online Platform for Multiscale Modeling
Effects of Dynamical Degrees of Freedom on Magnetic Compass Sensitivity: A Comparison of Plant and Avian Cryptochromes
Computational Reconstruction and Analysis of Structural Models of Avian Cryptochrome 4
Magnetic sensitivity of cryptochrome 4 from a migratory songbird
Tracking the Electron Transfer Cascade in European Robin Cryptochrome 4 Mutants