

## NITheCS Webinar Friday, 25 June 2021, 14h00

Dr Ismael Galván | National Museum of Natural Sciences, Spain

### “The quantum basis of organic evolution”



#### ABSTRACT

Mechanisms occurring at the atomic level are now known to drive processes essential for life, as revealed by quantum effects on biochemical reactions of metabolism. Some macroscopic characteristics of organisms may thus show an atomic imprint. Here I propose that this imprint may be transferred across organisms and affect their evolution independently of the genetic code. This may elucidate the appearance of two animal innovations with an unclear evolutionary origin: migratory behavior and flight ability. These traits may be mediated by quantum processes in two proteins: a radical pair mechanism in retinal cryptochrome providing essential magnetic orientation for migration, and quantum tunnelling in mitochondrial cytochrome c oxidase (CcO) providing the high aerobic capacity required for powered flight. Isotopes affect the performance of quantum processes, which may thus depend on cryptochrome and CcO isotopic compositions. I propose to test if animals have species-specific isotopic compositions in their constituent biomolecules, and if this explains why migratory behavior and flight ability has appeared only in certain species. These hypotheses may be tested by quantum mechanical modelling isotopic effects on radical pair mechanisms and quantum tunnelling. This should be combined with experimental determinations of cryptochrome and CcO isotopic compositions, to be compared between migrant vs. non-migrant and flying vs. flightless birds and mammals. This may represent a connexion between the mineral and the organic world that we could start to explore. With this aim, I propose to identify additional biological processes whose functioning may essentially be quantum and that may be key for the advance of quantum biology.

#### BIOGRAPHY

Dr Ismael Galván investigates in the field of evolutionary physiology, using (mostly) birds as study models. Dr. Galván obtained his Ph.D. in Biology by Complutense University of Madrid (Spain) in 2009, after which he was a postdoctoral researcher at the University of Paris-Sud 11 (France; 2010-2012), at the University of Lisbon (Portugal; 2013), and at Doñana Biological Station-CSIC (Spain; 2014-2019). He is currently permanent staff scientist at the National Museum of Natural Sciences-CSIC in Madrid. Dr Galván investigates at the interface of chemistry and biology, and is now interested in the idea that organic evolution can be fully understood only at an atomic scale.

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