

# Abstract for GR-TR Conference on Statistical Mechanics and Dynamical Systems

Talk Invited

Invited Talk

---

## How Nature performs super-efficient transport in complex networks

Filippo Caruso\*

LENS and Dipartimento di Fisica e Astronomia, Universit di Firenze, Via Nello  
Carrara 1, I-50019 Sesto Fiorentino, Italy

\* Electronic Address: [filippo.caruso@lens.unifi.it](mailto:filippo.caruso@lens.unifi.it)

Website: [www.qubiot.com](http://www.qubiot.com)

The uncontrollable interaction of a transmission network with a noisy environment is usually assumed to deteriorate its transport capacity, especially for quantum networks. However, for billions of years Nature has been implementing super-efficient, extremely fast, and remarkably robust energy transport in light-harvesting networks involved in photosynthesis. Motivated by very fascinating and recent breakthrough experiments, based on ultra-fast nonlinear spectroscopy of these pigment-protein photosynthetic complexes, we have investigated the key mechanisms by which noise may actually aid transport through a dissipative network by opening up additional pathways and suppressing the ineffective ones. One important ingredient is the presence of quantum coherence (experimental evidence) allowing the system to explore many different paths simultaneously. The second one is noise (theoretical evidence) enhancing the hopping probability between network sites and suppressing the destructive interference, that, otherwise, would trap energy (or information) in some localized states. These very recent achievements have given rise to a new exciting and rapidly developing research field, known as quantum biology, focused on the investigation of quantum effects in biological systems. An overview of our main achievements in this direction will be presented here. Finally, by deeper understanding of how Nature very well exploits quantum coherence and environmental noise to get very efficient and robust energy transfer, we might pave the way for the realization of a new generation of more powerful solar energy devices and ultrafast communication network technologies based on quantum phenomena.