UNIVERSITÀ
DEGLI STUDI
FIRENZE
DINFO
DIPARTIMENTO DI
INGEGNERIA
DELL'INFORMAZIONE

AVVISO DI SEMINARIO

From Quantum Biology to Bio-Engineering

Dott. Filippo Caruso

LENS, QSTAR & Dipartimento di Fisica e Astronomia, Università di Firenze, via Nello Carrara 1, I-50019 Sesto Fiorentino, Italy

Sala riunioni – Dipartimento di Ingegneria dell'Informazione
Venerdì 15 luglio, ore 10:30

Abstract - Recent theoretical and experimental efforts have shown the remarkable and counterintuitive role of noise [1] in enhancing the transport efficiency of complex quantum systems, with particular relevance to the energy transport in natural light-harvesting photosynthetic proteins. Here, we show both theoretically and experimentally three different simulators of such quantum phenomena, respectively based on optical fiber cavity networks, integrated photonics, and genetically engineered viruses. The first one is based on a simple, scalable, and controllable optical fiber cavity network that allows us to analyze the performance of transport networks for different conditions of interference, dephasing, and disorder [2]. Concerning the second one, by mapping the maze problem in an integrated waveguide array, probed by coherent light, we successfully test our theoretical result that a quantum walker can efficiently reach the output of a maze by partially suppressing the presence of interference, with an unprecedented improvement in the transport efficiency [3]. Finally, on the biological side, we have also created a tunable material consisting of a connected chromophore network on an ordered biological virus template at room temperature, and, using genetic engineering, we have established a link between the inter-chromophoric distances and emerging quantum transport properties [4]. These platforms are very promising simulators of quantum transport phenomena and could be used, in particular, to design and test optimal topologies of artificial nano-structures for future bio-inspired solar energy and quantum communication technologies.

[1] F. Caruso, V. Giovannetti, C. Lupo, and S. Mancini, "Quantum channels and memory effects", Rev. Mod. Phys. 86, 1203 (2014).
[2] S. Viciani, M. Lima, M. Bellini, and F. Caruso, "Observation of Noise-Assisted Transport in an All-Optical Cavity-Based Network", Phys. Rev. Lett. 115, 083601 (2015), PRL Editors' Suggestion.
[3] F. Caruso, A. Crespi, A.G. Ciriolo, F. Sciarrino, and R. Osellame, "Fast Escape of a Quantum Walker from an Integrated Photonic Maze", Nature Communications 7, 11682 (2016).
[4] H. Park, N. Heldman, P. Rebentrost, L. Abbondanza, A. Iagatti, A. Alessi, B. Patrizi, M. Salvalaggio, L. Bussotti, M. Mohseni, F. Caruso, H.C. Johnsen, R. Fusco, P. Foggi, P.F. Scudo, S. Lloyd, and A.M. Belcher, "Enhanced energy transport in genetically engineered excitonic networks", Nature Materials 15, 211–216 (2016).

Biography - Filippo Caruso got his PhD in Physics in Scuola Normale Superiore of Pisa and then he was awarded consecutively two European Marie-Curie Fellowships for 2 and 4 years, respectively. After his postdoc experience abroad, in UK and in Germany, as PI of a three-year grant by the Italian Ministry of Research, he started his independent research group as tenure-track assistant professor back in his own country. His research interests mainly include quantum transport phenomena, quantum biology, open quantum systems, quantum information science, complex systems and bio-inspired quantum technologies (www.qdab.org).

Dipartimento di Ingegneria dell'Informazione
Via S. Marta, 3 – 50134 Firenze
Fax +39 055 2758570 | e-mail: amministrazione@dinfo.unifi.it posta certificata: dinfo@pec.unifi.it
P.IVA | Cod. Fis. 01279680480