Politecnico di Torino

Dipartimento di Ingegneria Meccanica e Aerospaziale

SEMINAR

2021 September 10

Cooperative quantum effects from THz to GHz: Evolution of superradiant states in mechanically oscillating tubulin architectures

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Room 7 from 10:00 to 11:00

Abstract:

We have predicted that highly symmetrical arrangements of tryptophan chromophores in tubulin architectures, particularly those found in eukaryotic cytoskeletons, exhibit superradiance in the ultraviolet regime. The hallmarks of this cooperative quantum effect, where a system of N two-level systems is excited into coherent superposition by weak photoexcitation, are a fluorescence intensity increase that scales as NM with the number of photoexcitations M and a lifetime shortening that scales inversely with the system size. Counterintuitively, such an effect enhances robustness to disorder with larger system sizes, defying the commonly held expectation that quantum effects must be entirely washed out in warm, wet, and wiggly biological environments. We are actively pursuing experimental verification with colleagues in femtosecond spectroscopy to observe signatures of ultraviolet superradiance in time-resolved fluorescence measurements. As a prelude to planned collaborative work with the Deriu group at Politecnico, I will explore in this seminar the possibility of connecting our results to completed simulations of microtubule mechanical vibrations in the gigahertz range.

BIO - Philip Kurian

Philip is a theoretical physicist, (re)search(ing) scientist, founding director of the **Quantum Biology Laboratory at Howard University**, and visiting research professor at the **Iowa Advanced Technology Laboratories**. He is a Fulbright Scholar (Trieste) and recipient of awards from the Argonne and Oak Ridge Leadership Computing Facilities, National Science Foundation, and the National Institutes of Health. He serves as principal investigator for the first Guy Foundation-funded project outside the UK ("Cooperative and coherent quantum phenomena in the life sciences") and as the theory lead on an international research coordination network to develop instrumentation for quantum sensing and information processing in complex biological environments. His vision is to uncover how fundamentally quantum interactions can produce biological manifestations at the mesoscopic and clinical scales, including in neurodegeneration, cancer, immunodiversity, oxidative metabolism, and human consciousness. As an advisor to the AAAS Dialogue on Science, Ethics, and Religion, Philip provides expertise to seminary professors on how to integrate frontier science topics into