Seminar/Talk

Probing scintillation physics and collective emission with quantum optics methods

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Host: Charles Roques-Carmes

Hanbury Brown and Twiss (HBT) interferometry, originally developed to measure stellar diameters, has become a central technique in quantum optics, offering insight into photon statistics and coherence. We apply time-resolved second-order correlation (2) () measurements to explore scintillation—the light emission following high-energy radiation excitation—in a range of condensed matter systems. Our study reveals strong photon bunching in rare-earth-doped garnets and perovskite nanocrystals, enabling precise extraction of scintillation lifetimes and light yields with sensitivity to temperature and X-ray flux. In nanocrystal superlattices just hundreds of nanometers in size, we observe (2) (0) values exceeding 50, demonstrating the intrinsic bunching effects scintillated light have. Beyond intrinsic emission analysis, we report a collective radioluminescence phenomenon in ensembles of coupled perovskite quantum dots under X-ray excitation. Here, a single high-energy photon triggers multiple synchronized excitations via photoelectrons, producing superfluorescent emission with broadened spectra, shifted peaks, and ultrafast lifetimes down to 230 ps—14× faster than roomtemperature spontaneous emission. These observations align with many-body quantum optics theory and establish a new mechanism for enhancing scintillation. ***Shaul is currently completing his Ph.D. at the Technion – Israel Institute of Technology in the AdQuanta group, under the supervision of Prof. Ido Kaminer. His research integrates quantum optical techniques and effects—such as Hanbury Brown and Twiss (HBT) interferometry and superfluorescence—with X-ray science, aiming to enhance the performance of X-ray radiation detectors. Shaul will join ISTA as a postdoctoral researcher in 2026. Previously, he earned his M.Sc. in Materials Engineering at the Technion, working under the supervision of Prof. Elad Koren. His master's research focused on monolayer transition metal dichalcogenides, specifically investigating transitions between bright and dark excitonic states. He holds dual B.Sc. degrees from the Technion in Materials Engineering and Chemistry.

Wednesday, October 22, 2025 10:30am - 11:30am
Mondi 3 / Central Building

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