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Quantum micromachines and IR bioluminescence

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Interactions of states storing excess energy in a system with energy flow can lead to avalanche energy releases (Self-Organized Criticality scenario), to correlations in energy releases in luminescence, electron emission, and other complex dynamics. While processes of uncontrolled releases of stored energy led to quantum errors and decoherence in quantum computers, these processes and correlations are regarded as essential for understanding live system functioning and live origin. There were no tools to look at these states and interactions inside live cells directly, but progress in detector technologies is making it possible. A multi-pixel array of Superconducting Nanowire Single Photon Detectors installed in the focal plane of a cooled IR grid monochromator is capable of detecting and time-stamping with resolution in ps scale all IR photons emitted by an object of live cell size in the wavelength region 1-30 μm. Here, "ALL" means random thermal background radiation emission and IR cell bio-luminescence, either self-(chemo-) luminescence accompanying cell biochemical processes or induced luminescence caused by intentional excitation of biomolecules with pulsed IR light source with controlled spectrum. Analyzing spectral and time patterns in the induced luminescence spectrum can provide real-time information on biochemical changes- i.e., functional imaging of live cells. Self-luminescence accompanying about 108 biochemical reactions per second in the living cell can be detectable. Detectors' time resolution and energy sensitivity are expected to improve, as well as capabilities in computer learning for time and spectral pattern analysis techniques for the "Big Data." IR emission of live samples can be coupled to a cryogenic monochromator and detector system with IR fibers, so the whole design can be compact and mass-produced for use in biomedical laboratories or can be installed on an unmanned mission to look for chemical and dynamical signatures of microbial life on other planets.
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Early Career

No

Primary author: PEREVERZEV, Sergey (LLNL)

Presenter: PEREVERZEV, Sergey (LLNL)

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