Closed quantum Master equations for energy transfer in Light-Harvesting complex and multi-exciton dynamics

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Usually the study of energy-transfer in the Light Harvesting Complex is limited by a single-exciton motion along the antenna. Starting from the many-body Schrodinger equation, we derived the Lindblad-type Master equations describing the cyclic exciton-electron dynamics of the Light Harvesting Complex, due to charge-restoration of a donor 1]. These equations, which resemble the Master equations for electric current in mesoscopic systems [2], go beyond the single-exciton description by accounting the multi-exciton states accumulated in the antenna, as well as the charge-separation, fluorescence and initial photo-absorption. Although these effects take place on very different time-scales, we demonstrate that their account is necessary for consistent description of the exciton dynamics. We applied our results for evaluation of the energy (exiton) current and the (damaging) fluorescent current as a function of light-intensity.

[1] Shmuel Gurvitz, Gennady P. Berman and Richard T. Sayre, arXiv:1706.01958.

[2] Shmuel Gurvitz, Front. Phys. 12 (2017) 120303.