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Multipartite Quantum Entanglement Evolution in Photosynthetic Complexes[1] SAM RODRIQUES, BENJAMIN BROCK, PETER LOVE, Haverford College, JING ZHU, SABRE KAIS, Purdue University, ALAN ASPURU-GUZIK, Harvard University — We investigate the presence of quantum entanglement in the Fenna-Matthews-Olson complex (FMO), a protein complex in the photosynthetic pathway of green sulfur bacteria which is involved in exciton transport at nearly 100% efficiency. We present a novel optimization algorithm for calculating entanglement in open systems, and apply it to 5-site entanglement calculations in FMO simulations. We find that significant entanglement exists if exactly one exciton is assumed to reside in the FMO at all times, and that this entanglement can be described almost exclusively using bipartite entanglement monogamy, without resort to multipartite entanglement measures. Our results support the hypothesis that entanglement occurs primarily along the transport pathways in the FMO. However, we also find that the entanglement quickly goes to zero if one includes non-zero amplitudes in the two-exciton subspace, indicating that further work is required to understand the mechanism by which excitons enter the FMO.

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