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Concatenated quantum codes in biological systems[1] SETH LLOYD, Massachusetts Institute of Technology — This talk investigates how biological systems such as photosynthetic bacteria use quantum coding techniques such as decoherent subspaces, noiseless subsystems, and concatenated quantum codes to engineer long exitonic lifetimes and rapid energy transport. The existence of hierarchical structures in photosynthetic complexes is associated with concatenated quantum codes. A concatenated code is one that combines two or more codes to construct a hierarchical code that possesses features of all its constituent codes. In photosynthetic complexes, structures at the smallest level use quantum coding techniques to enhance exciton lifetimes, and structures at higher scales possess symmetries that enhance exciton hopping rates. The result is a concatenated quantum code that simultaneously protects excitons and enhances their transport rate. All known quantum codes can be described within the framework of group representation theory. This talk reviews the relationship between symmetry and quantum codes, and shows how photosynthetic bacteria and plants put quantum coding techniques to use to improve the efficiency of photosynthetic transport.

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