Every Tree is a Quantum Mechanic

We recently reported on a breakthrough in artificial photosynthesis. Now, new experiments at Lawrence Berkeley National Laboratory and UC Berkeley have shown that photosynthesis uses quantum entanglement to harvest sunlight for electrochemical energy at near-perfect efficiency. (Earlier experiments had shown that photosynthesis utilized quantum mechanical effects, but this is the first to show the use of quantum entanglement.)

Quantum entanglement is an aspect of particle physics so bizarre that Einstein could never accept it (he famously referred to it as "spooky action at a distance"). When two or more atomic-scale particles such as electrons become entangled, they stay linked and act as a single object: a change in one is instantly reflected in the other, no matter how far apart they become.

These new experiments with the Fenna-Matthews-Olson (FMO) photosynthetic light-harvesting protein found in green sulfur bacteria show that solar photons generate coherent, wavelike oscillations in the protein complexes. These "quantum beating" signals enable the donor and acceptor molecules to sample all potential energy pathways at once, and choose the most efficient.

This is the first time entanglement has been shown in the complex chemical environment and at the relatively high temperatures of a biological system, and for relatively long timescales. (Picoseconds are a long time in the quantum world.) The knowledge could be applied to improve artificial photosynthetic systems and quantum computers.

So, while scientists are only now figuring out how to use quantum entanglement for teleporting information and energy, in macroscale mechanical systems, or possibly to power a faster-than-light spacecraft, it turns out every plant on Earth has already been using it for useful work. And plants inherited that ability from their cyanobacteria ancestors, who started using it at least 2.4 billion years ago. Now that's spooky.