Further Evidence That Photosynthesis Involves Quantum Mechanics

Biologists have recently had cause to wonder whether the molecules they know and love are pulling some quantum trickery while they're not looking: one of the large proteins that captures light in photosynthesis was observed in several studies apparently using coherence, one of the hallmarks of quantum mechanics, to determine the best possible route for shunting energy through its atoms. Now, further experiments that use lasers to tweak such proteins and observe their response have provided more evidence that this is happening—an exciting indication that the strange laws of quantum mechanics can affect the behaviors of large agglomerations of atoms.

Our own Sean Carroll of Cosmic Variance explained how coherence works when this phenomenon was observed in real plants at room temperature last year:

We can think about this in terms of Feynman’s way of talking about quantum mechanics: rather than a particle taking a unique path between two points, as in classical mechanics, a quantum particle takes every possible path, with simple paths getting a bit more weight than complicated ones. In the case of the [photosynthesis] protein, different paths for the energy might be more or less efficient at any particular moment, but this bit of quantum trickery allows the energy to find the best possible route at any one time. Imagine at rush hour, if your car could take every possible route from your home to the office, and the time it officially took would be whatever turned out to be the shortest path. How awesome would that be?

The reason you can't do that is that your car is a giant macroscopic object that can’t really be in two places at once, even though the world is governed by quantum mechanics at a deep level. And the reason for that is decoherence — even if you tried to put your car into a superposition of “take the freeway” and “take the local roads,” it is constantly interacting with the outside world, which “collapses the wave function” and keeps your car looking extremely classical.

Proteins in plants aren’t as big as cars, but they’re still made of a very large number of atoms, and they’re constantly bumping into other molecules around them. That’s why it’s amazing that they can actually maintain quantum coherence long enough to pull off this energy-transport trick.
We humans, of course, are made up of a large number of molecules each made up of a large number of atoms. When we get these kinds of insights into quantum mechanics at the molecular level, it’s hard not wonder—what about our own bodies is quantum mechanical?