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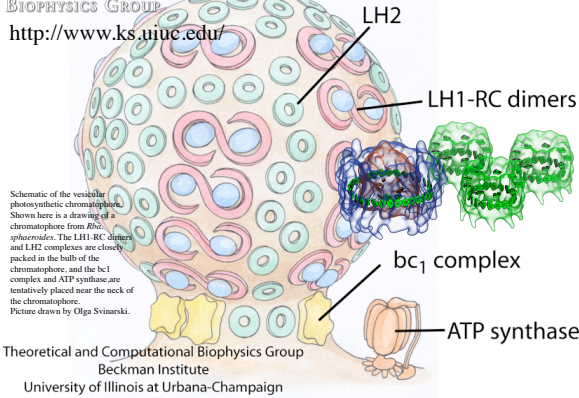
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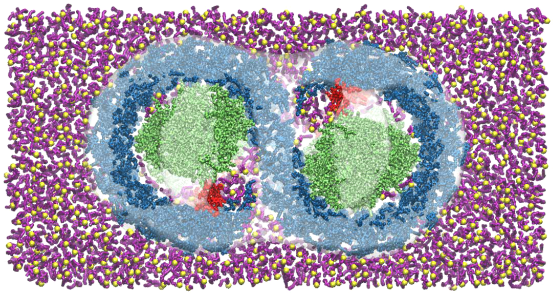
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### Reaction Centers and Light-Harvesting Complexes within the Chloroplast Membrane



Jen Hsin, James Gumbart, Leonardo G. Trabuco, Elizabeth Villa, Pu Qian, C. Neil Hunter, and Klaus Schulten. Protein-induced membrane curvature investigated through molecular dynamics flexible fitting. *Biophysical Journal*, 97:321-329, 2009. (PMC: 2711417)

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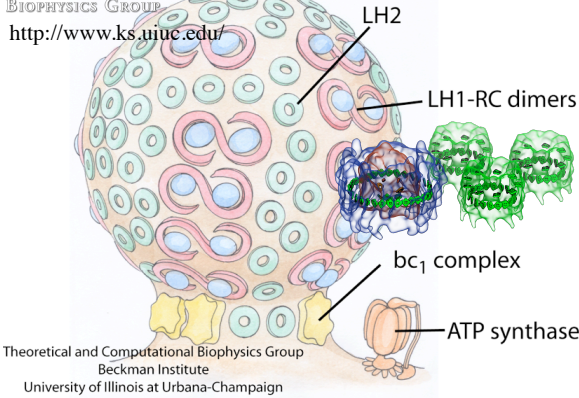
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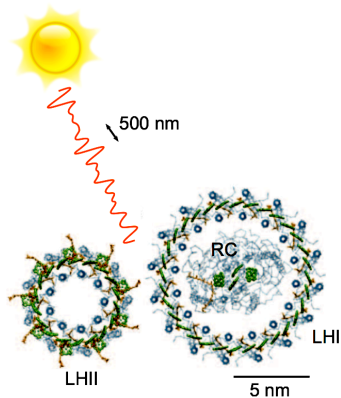
# quantum photosynthesis

Why I refuse to teach quantum tunneling mechanisms in Photosynthesis

$$\tau_{DA} = \frac{2\pi}{\hbar} \sum_{m \in D} \sum_{n \in A} \frac{e^{-E_m^D / k_B T}}{\sum_{l \in D} e^{-E_l^D / k_B T}} |V_{mn}^{DA}|^2 \int dE S_m^D(E) S_n^A(E)$$

## quantum photosynthesis

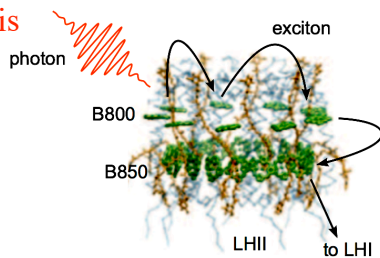
a. Sunlight: incoherent, stationary



Kassel, Yuen-Zhou and Rahimi-Keshari (2012) Does coherence enhance transport in photosynthesis? arXiv:1210.5022v1

## quantum photosynthesis

b. An inaccurate picture:

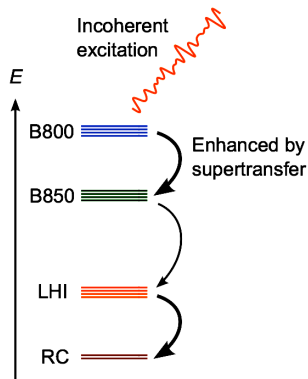


Kassel, Yuen-Zhou and Rahimi-Keshari (2012) Does coherence enhance transport in photosynthesis? arXiv:1210.5022v1

No light pulses  
No localised excitation  
No wavelike transport  
Microscopic coherence doesn't help

## quantum photosynthesis

c. A more accurate picture:

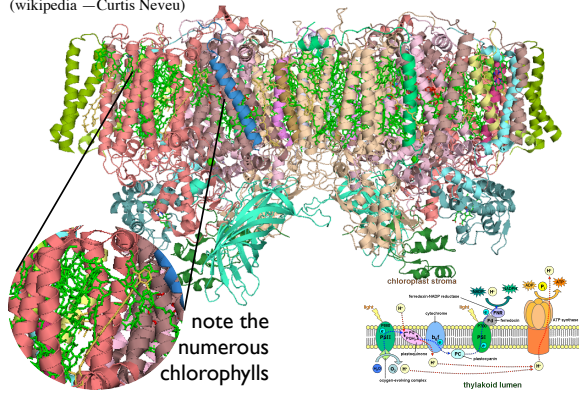


Kassel, Yuen-Zhou and Rahimi-Keshari (2012) Does coherence enhance transport in photosynthesis? arXiv:1210.5022v1



## Photosystem II (cyanobacteria)

(wikipedia —Curtis Neveu)



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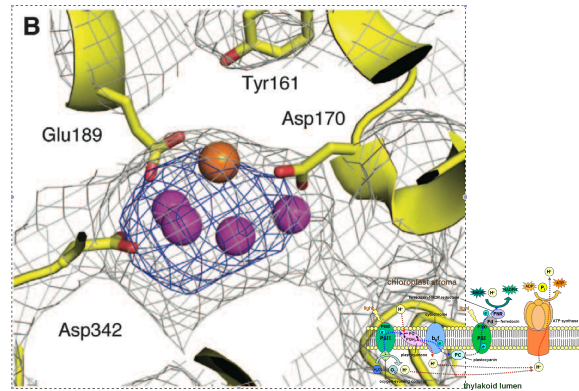
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## Photosystem II (water-splitting site)



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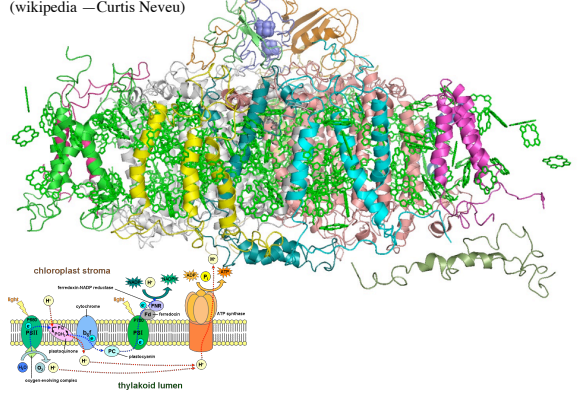
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## Photosystem I (plants)

(wikipedia —Curtis Neveu)



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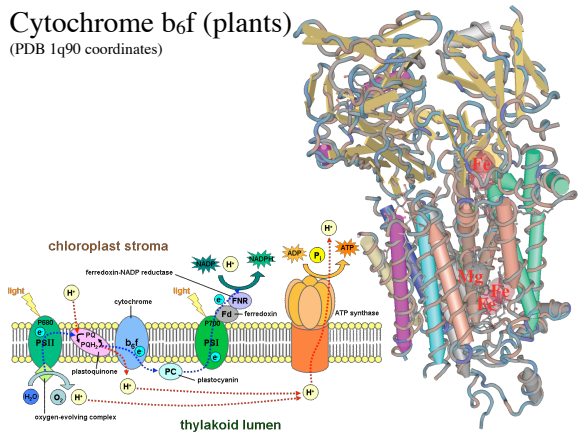
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## Cytochrome b<sub>6</sub>f (plants)

(PDB 1q90 coordinates)



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