

# Lessons from purple bacteria about how to harvest solar energy



First Winton Symposium, Oct. 2012.

## **Glasgow University**

June Southall  
Aleks Roszak  
Alastair T. Gardiner  
Mads Gabrielsen  
Tatas Brotosudarmo  
Chris Law  
Susan Kitson  
Steve Prince  
Gerry McDermott  
Andy Freer  
Tina Howard  
Neil Isaacs

## **Daresbury**

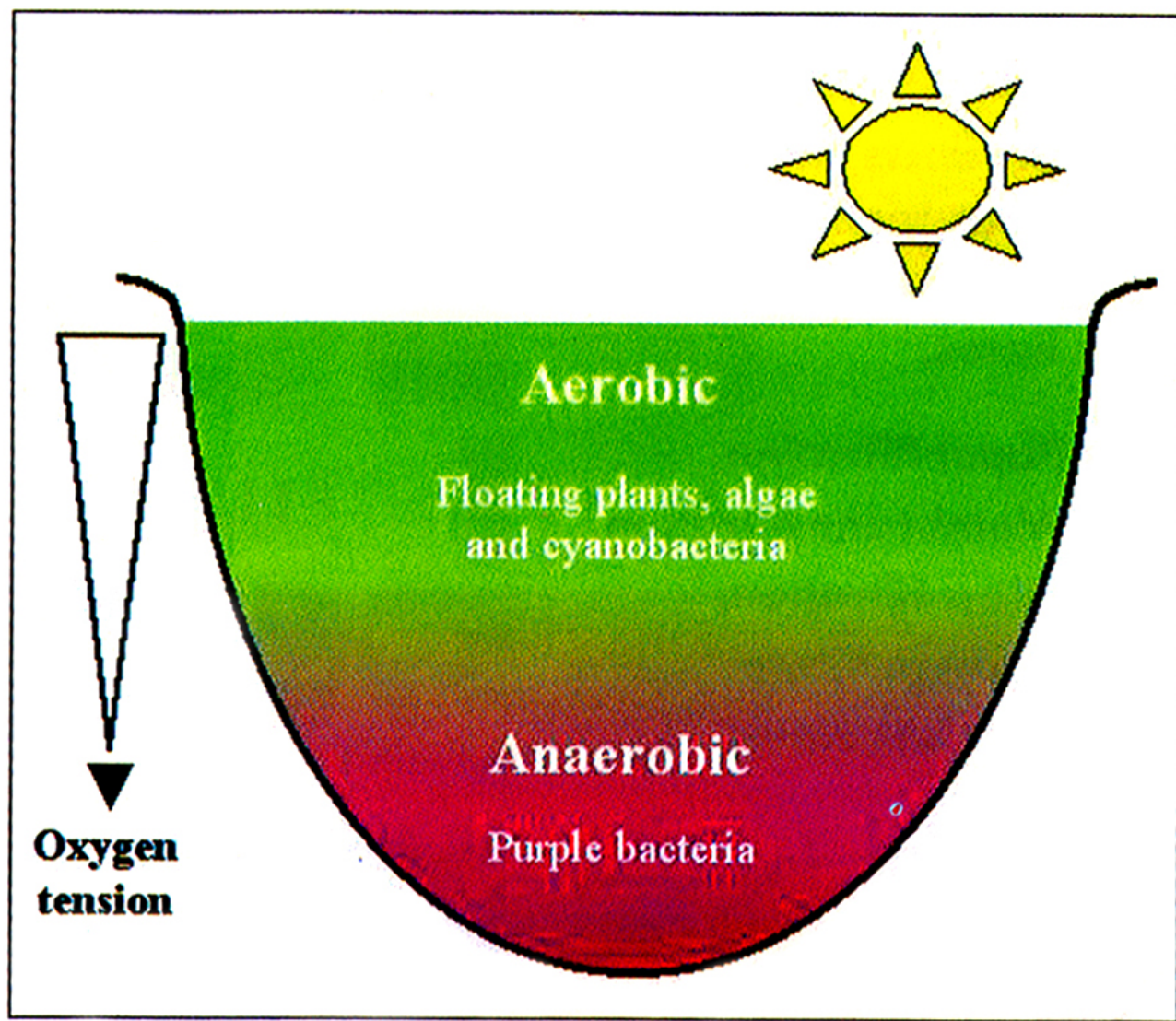
Miroslav Papiz  
Anna Lawless

## **Bayreuth**

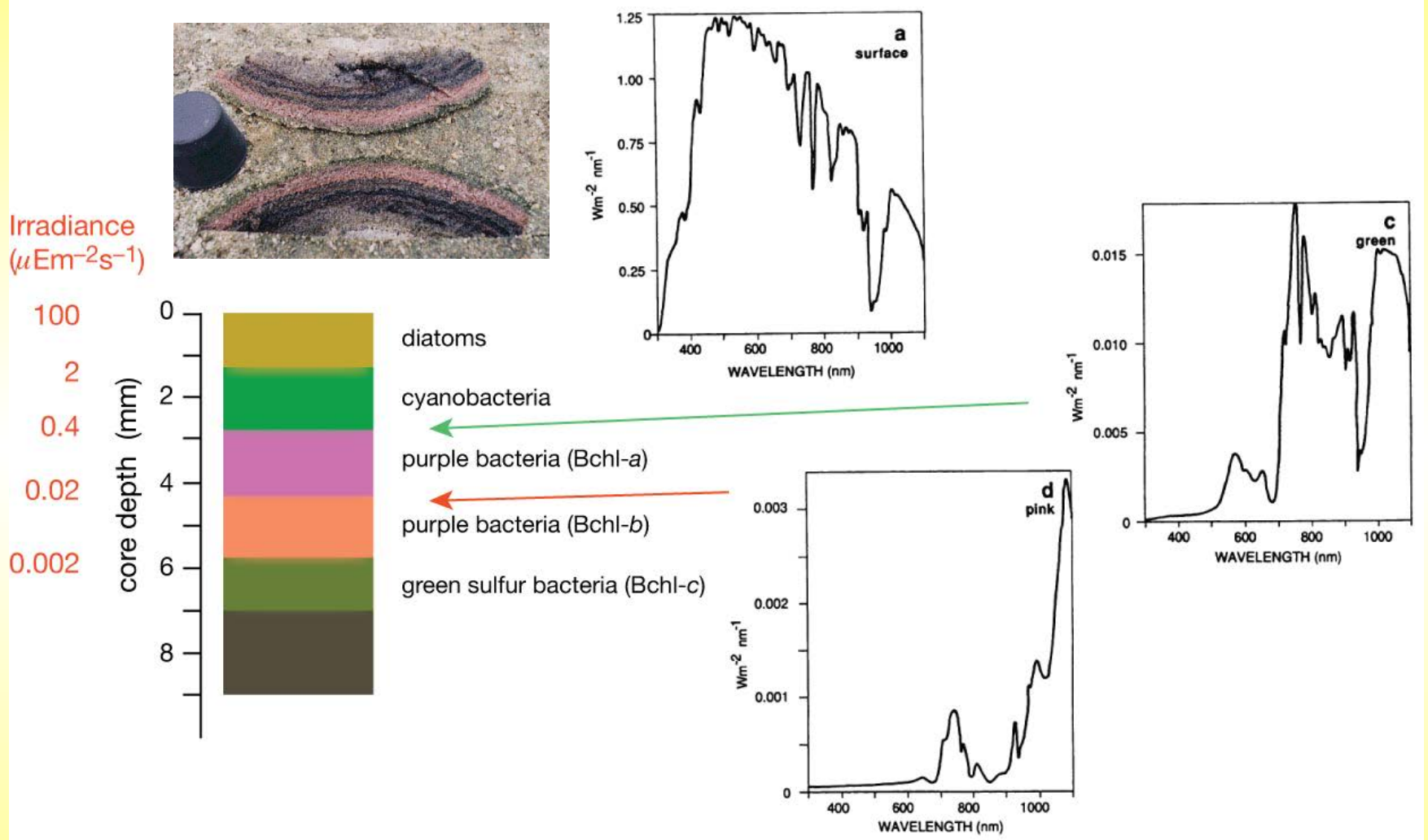
Juergen Kohler  
Juergen Baier  
Silke Oellerich  
Richard Hildner

## **ICFO Barcelona**

Daan Brinks  
Niek F. van Hulst



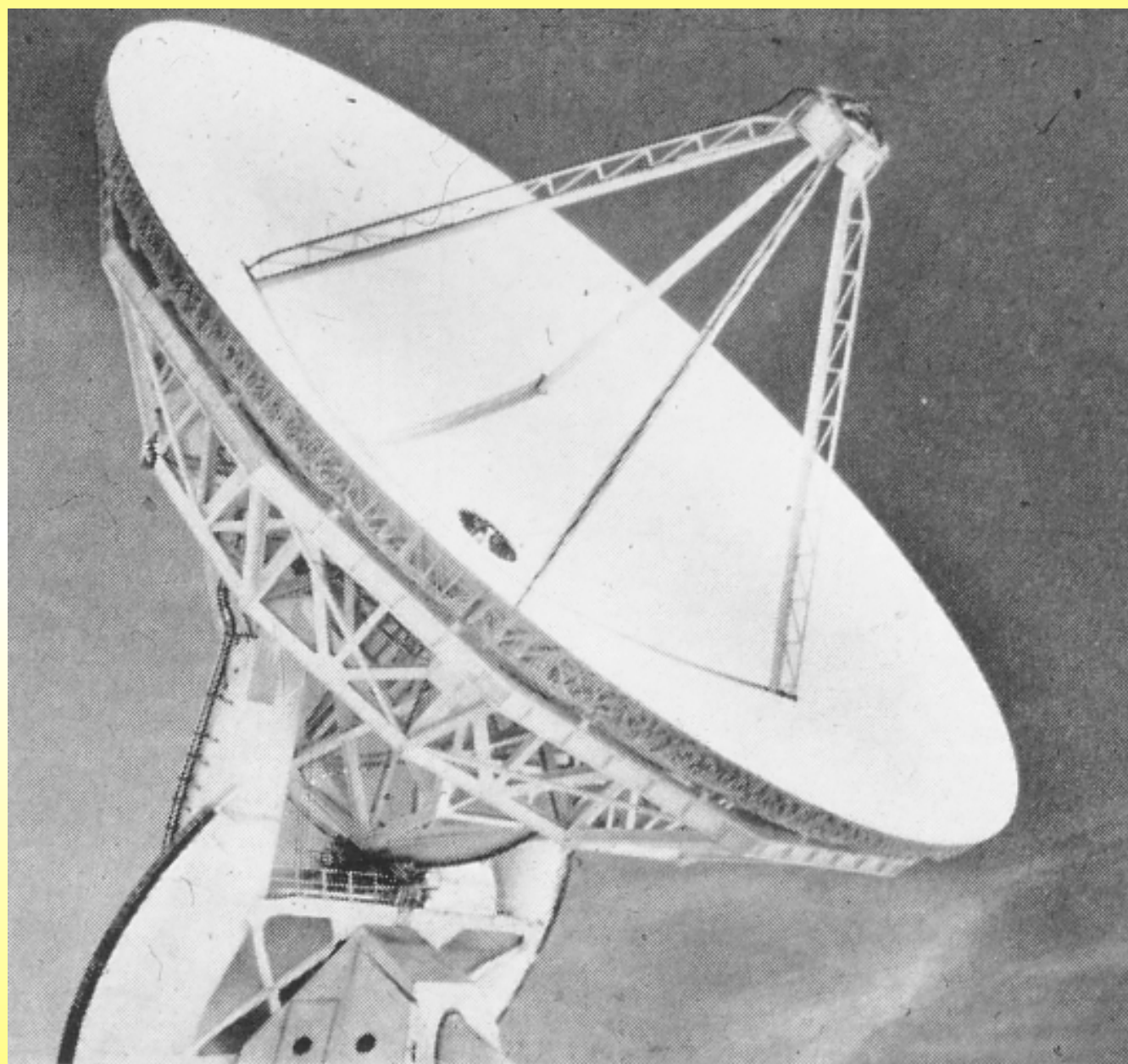
# Success in ecological niches



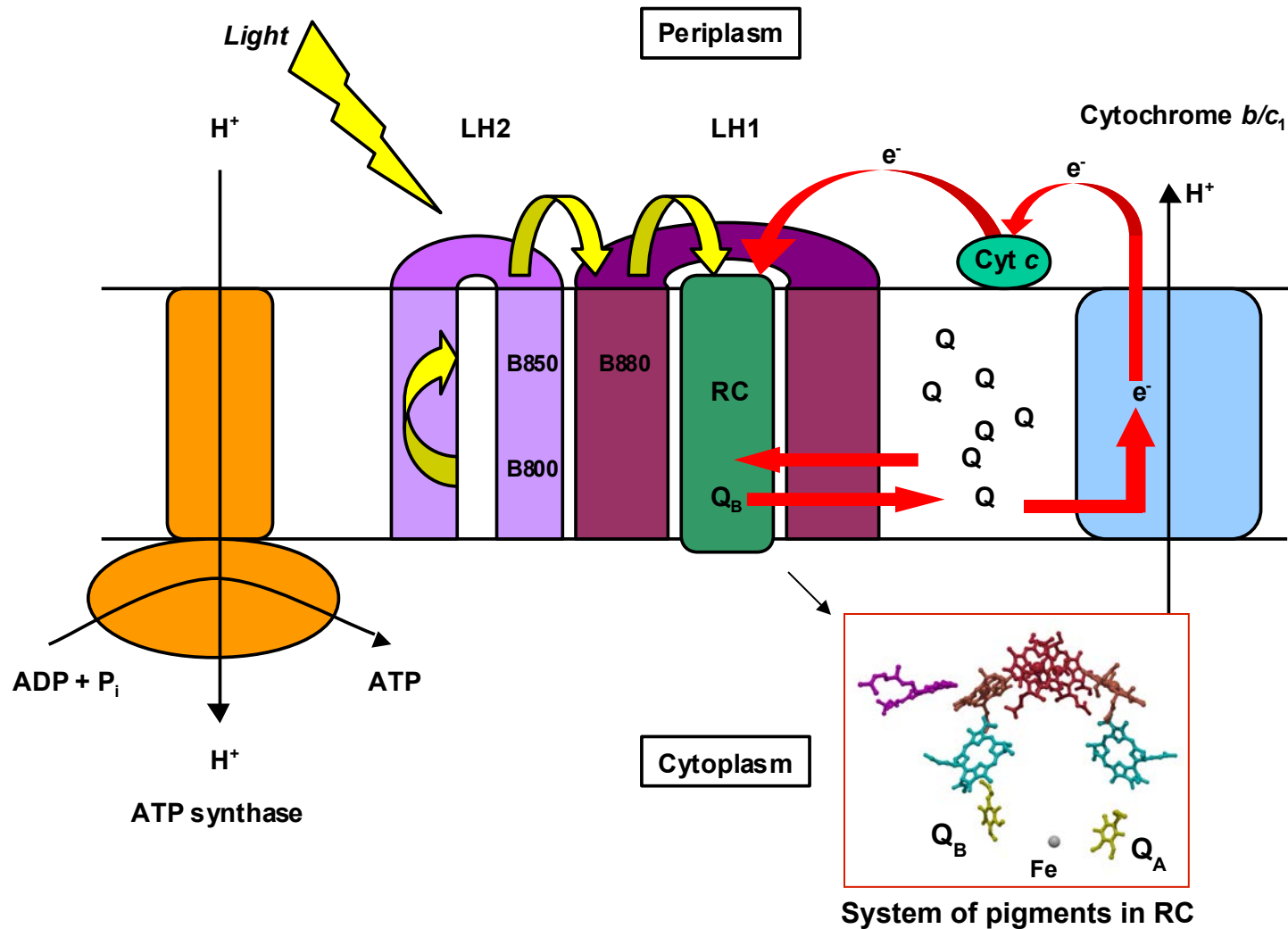
e.g. microbial mats from Sippewissett Salt Marsh

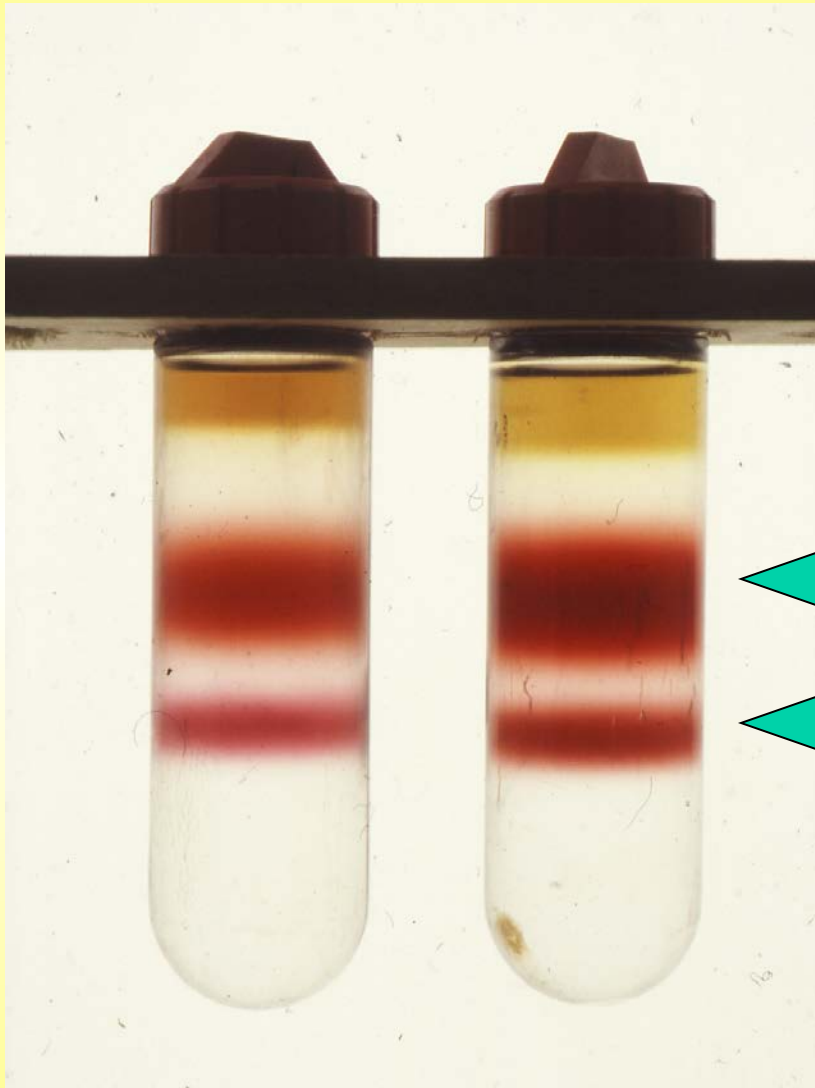
Pierson *et. al.* (1990) Appl. Environ. Microbiol





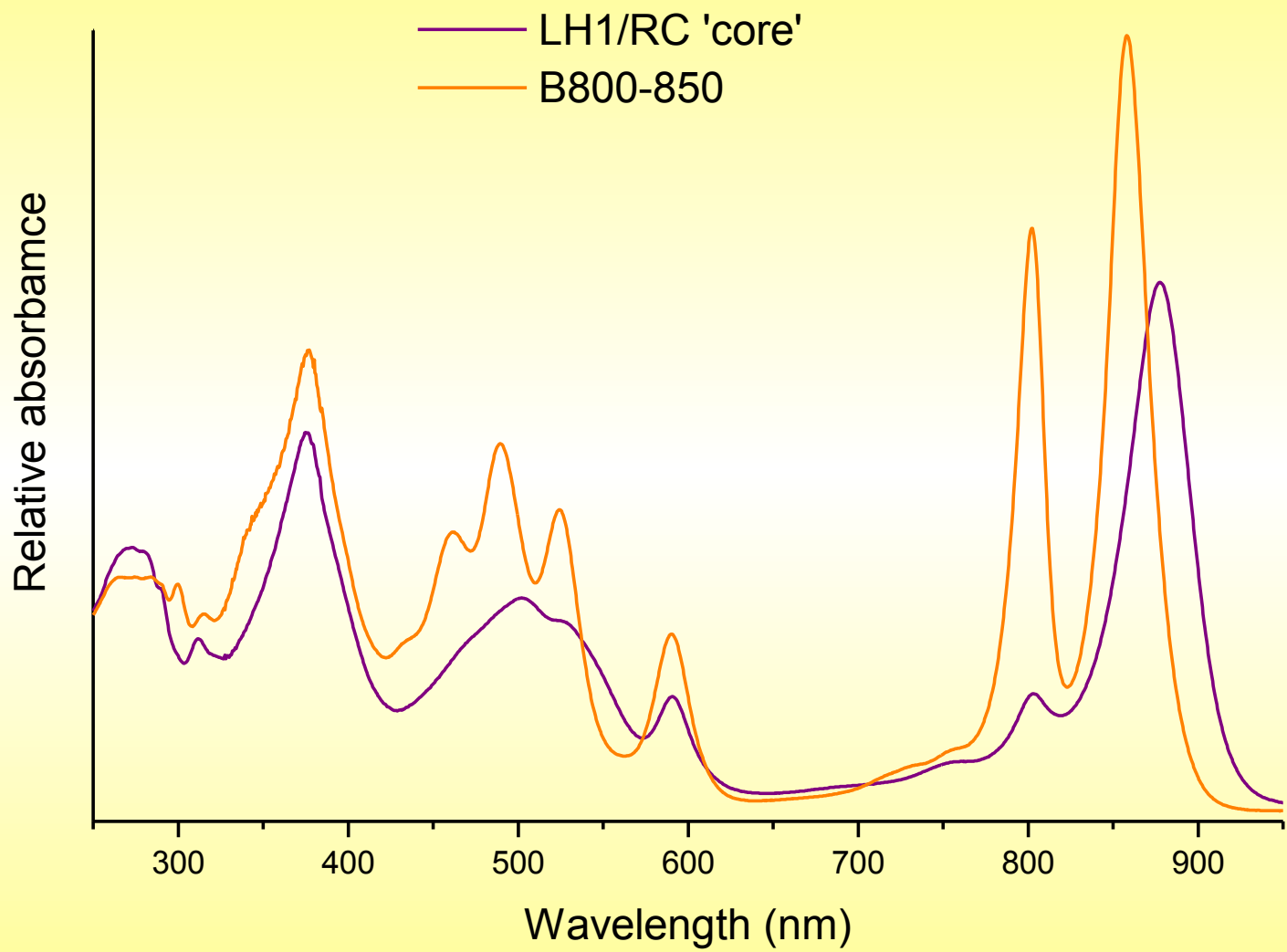
# Photosynthetic system of purple bacteria in the intracytoplasmic membrane



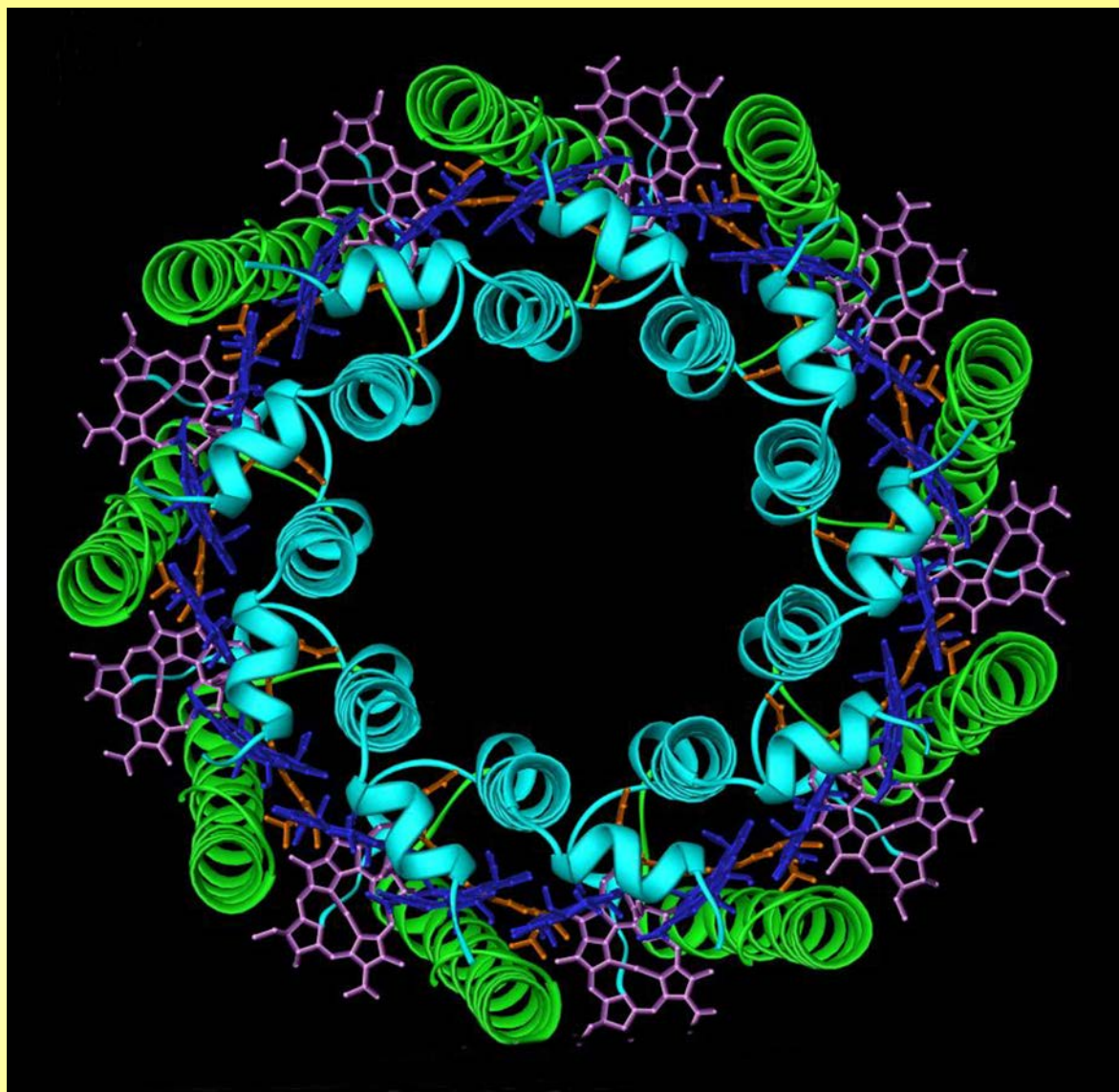


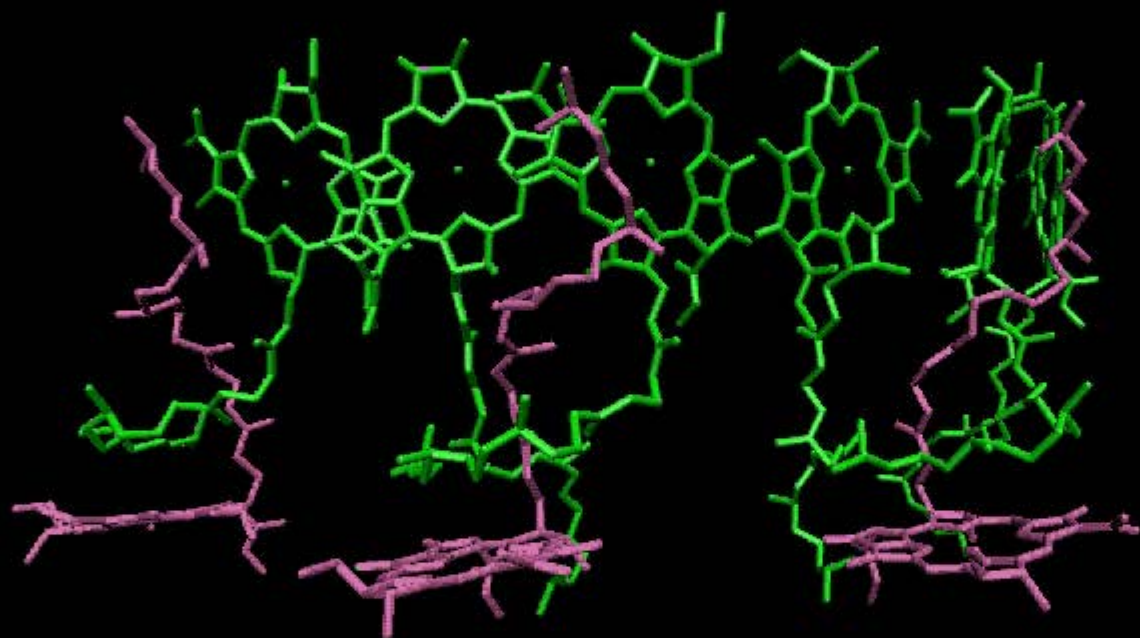
LH2

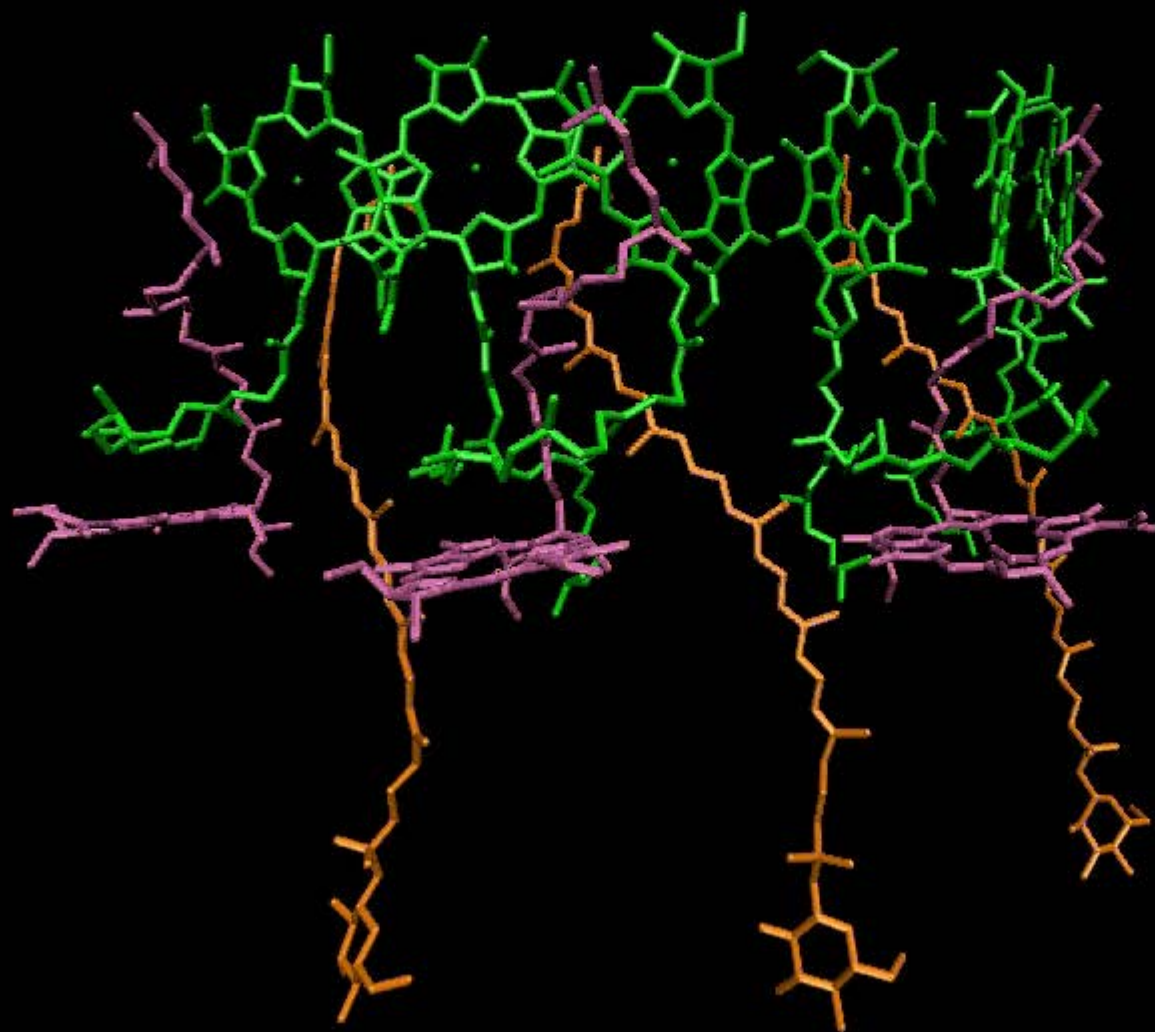
LH1/RC





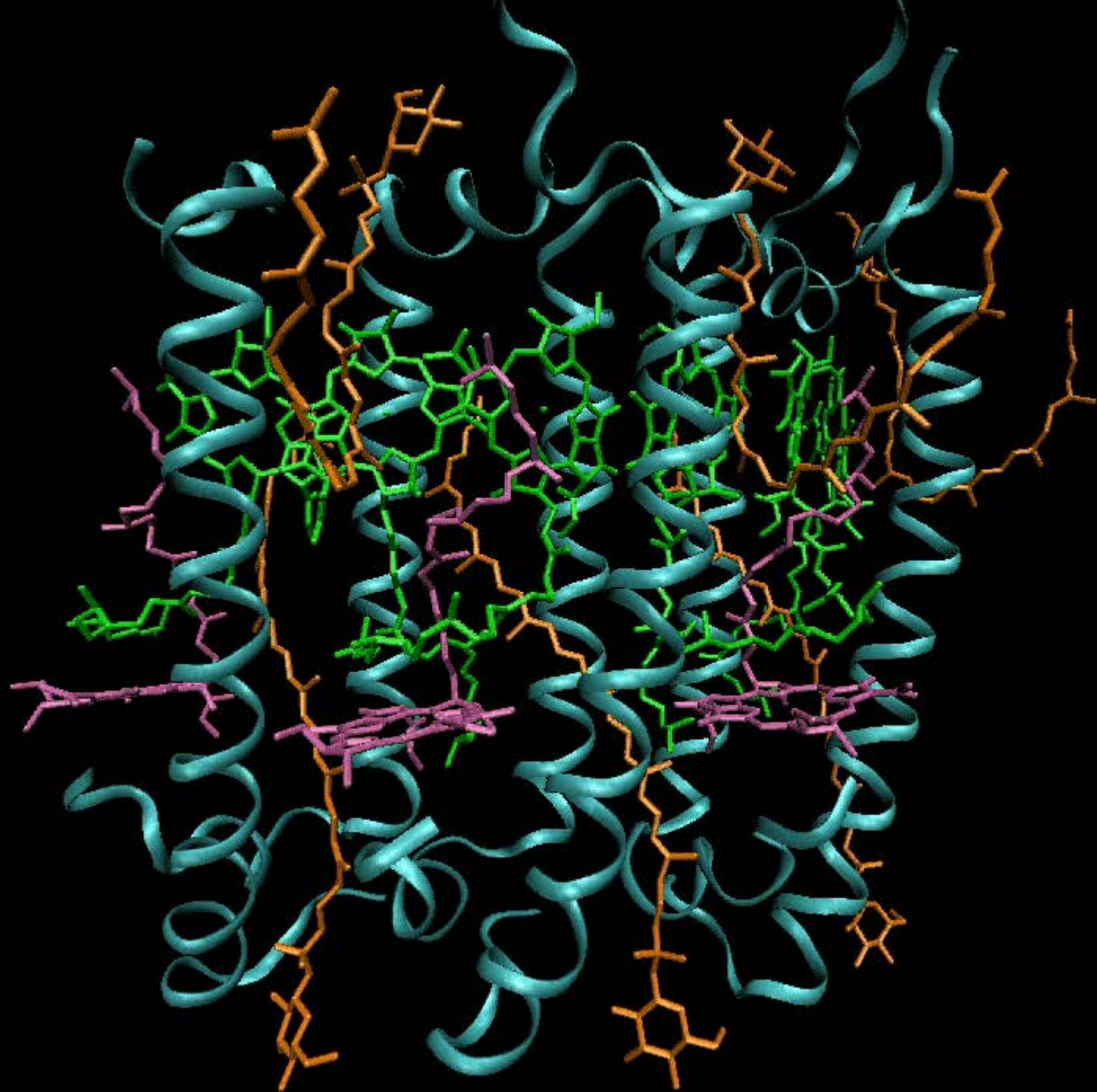




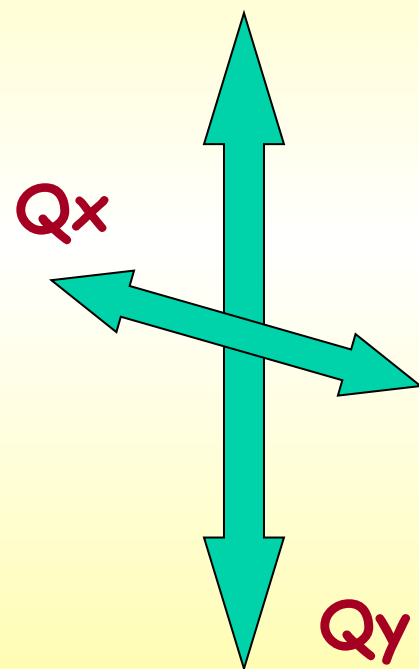
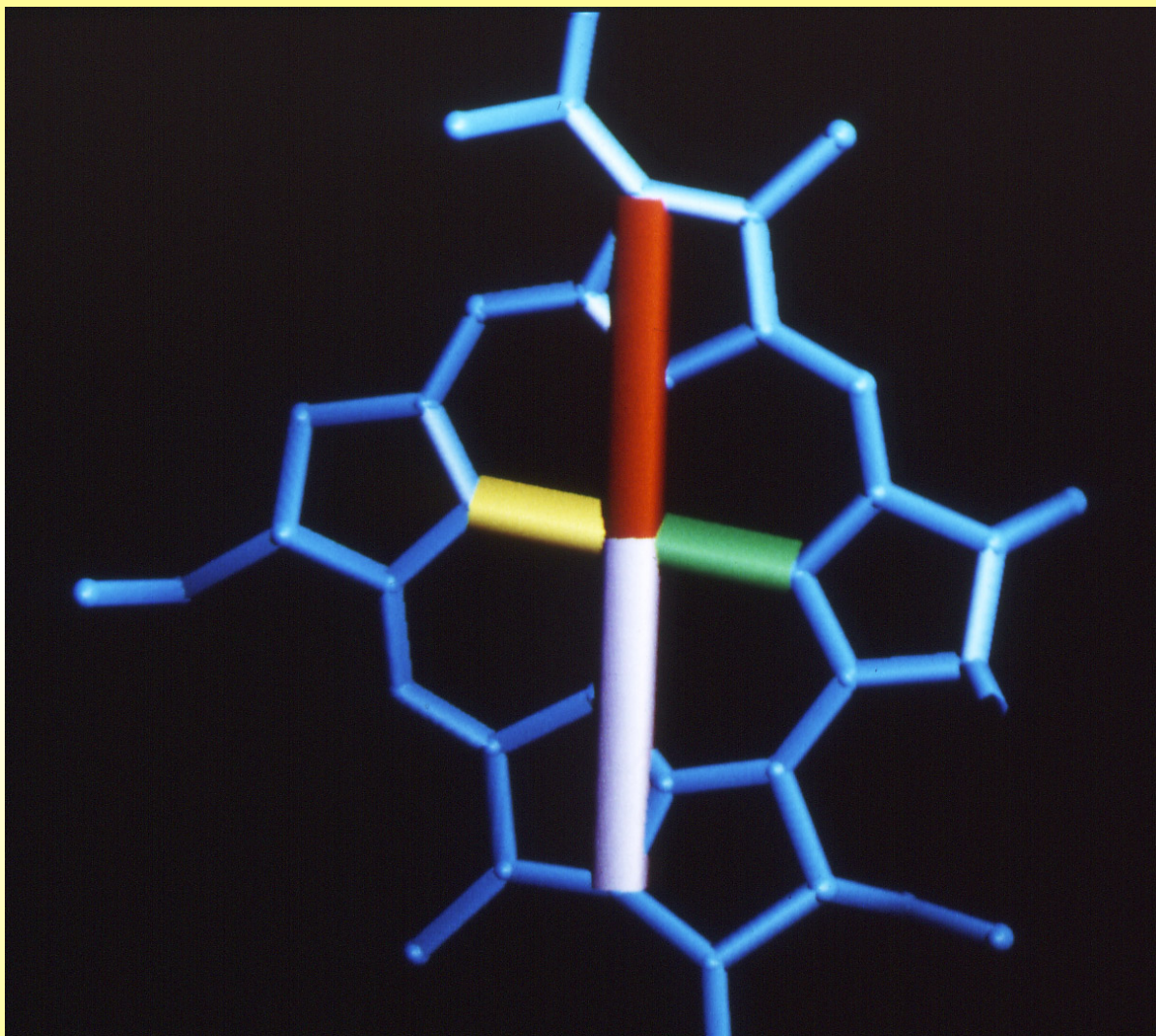


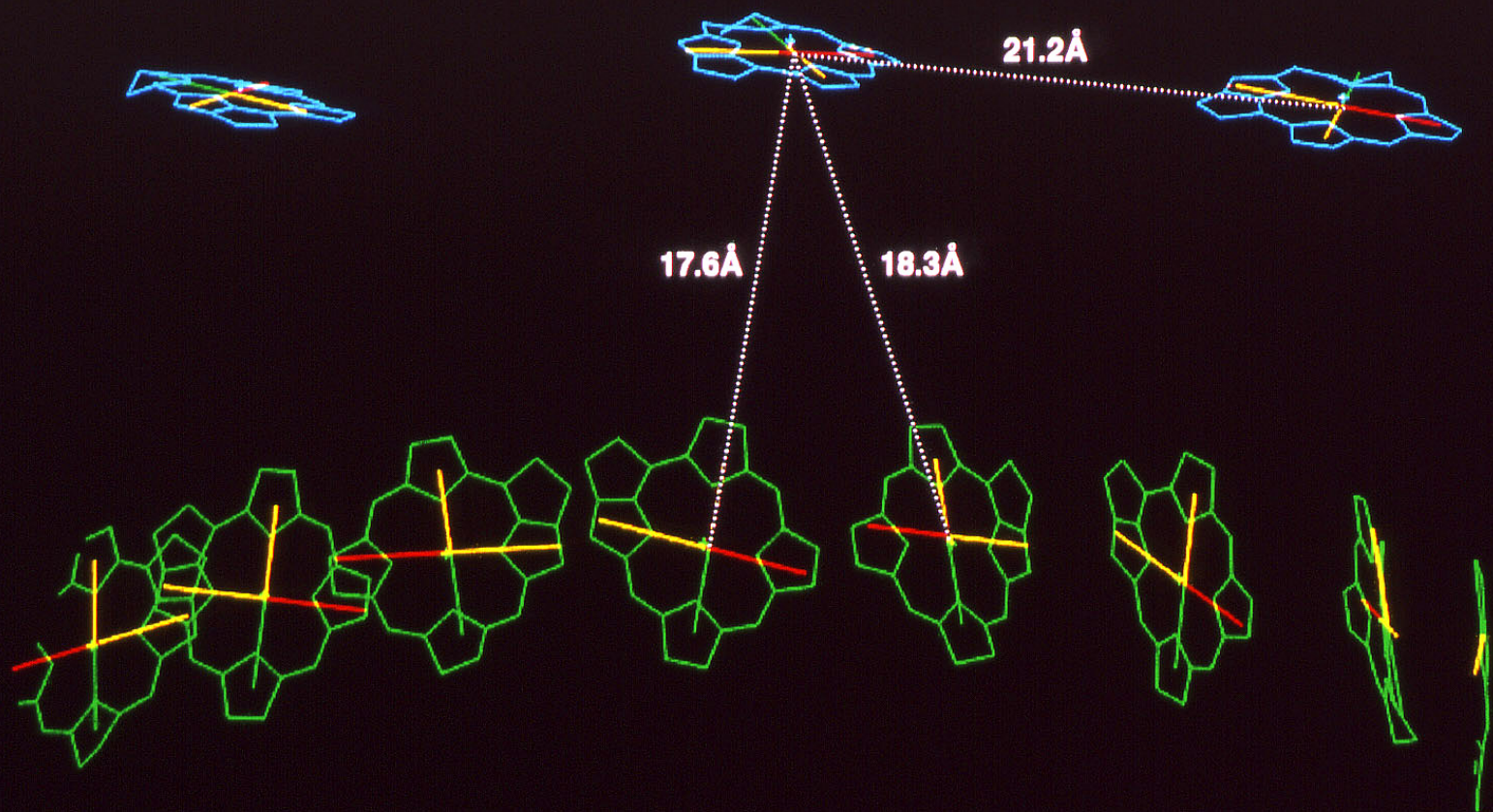






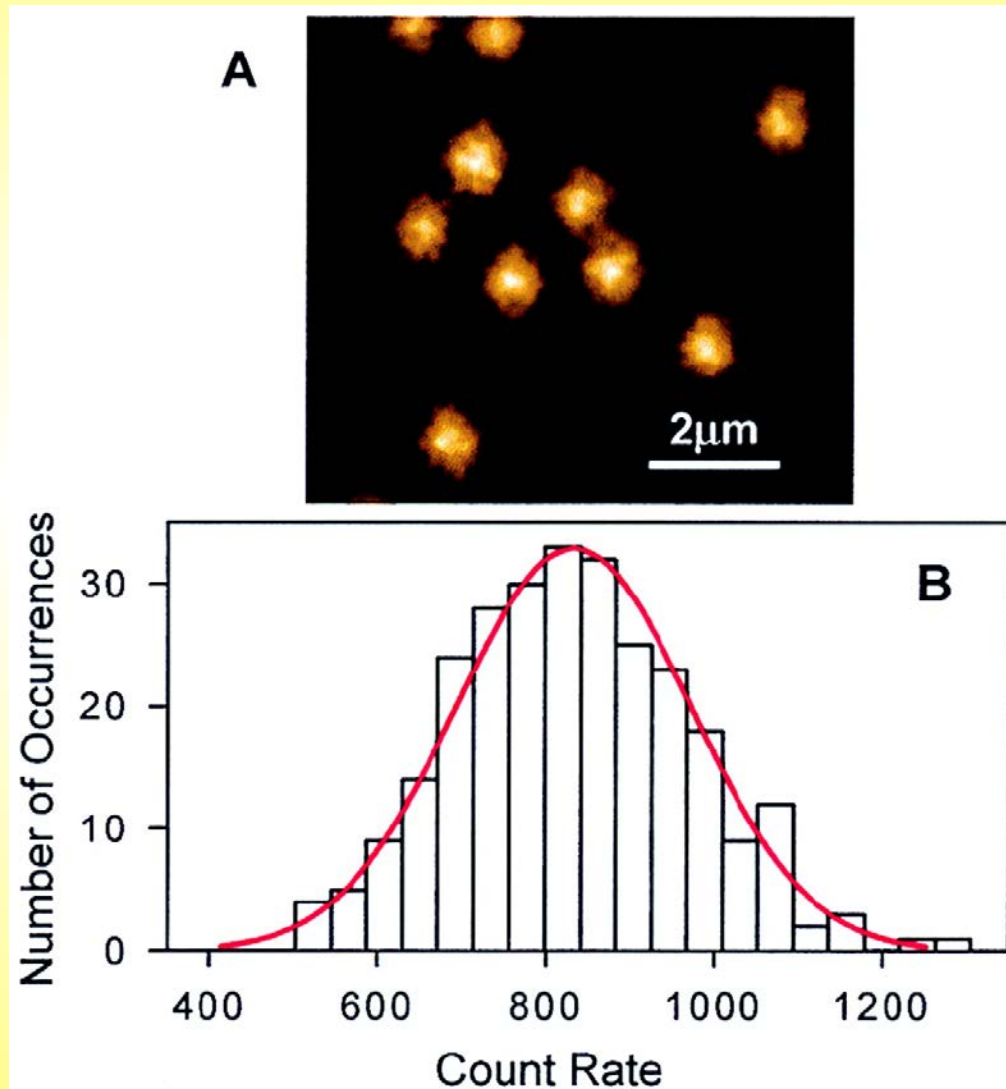


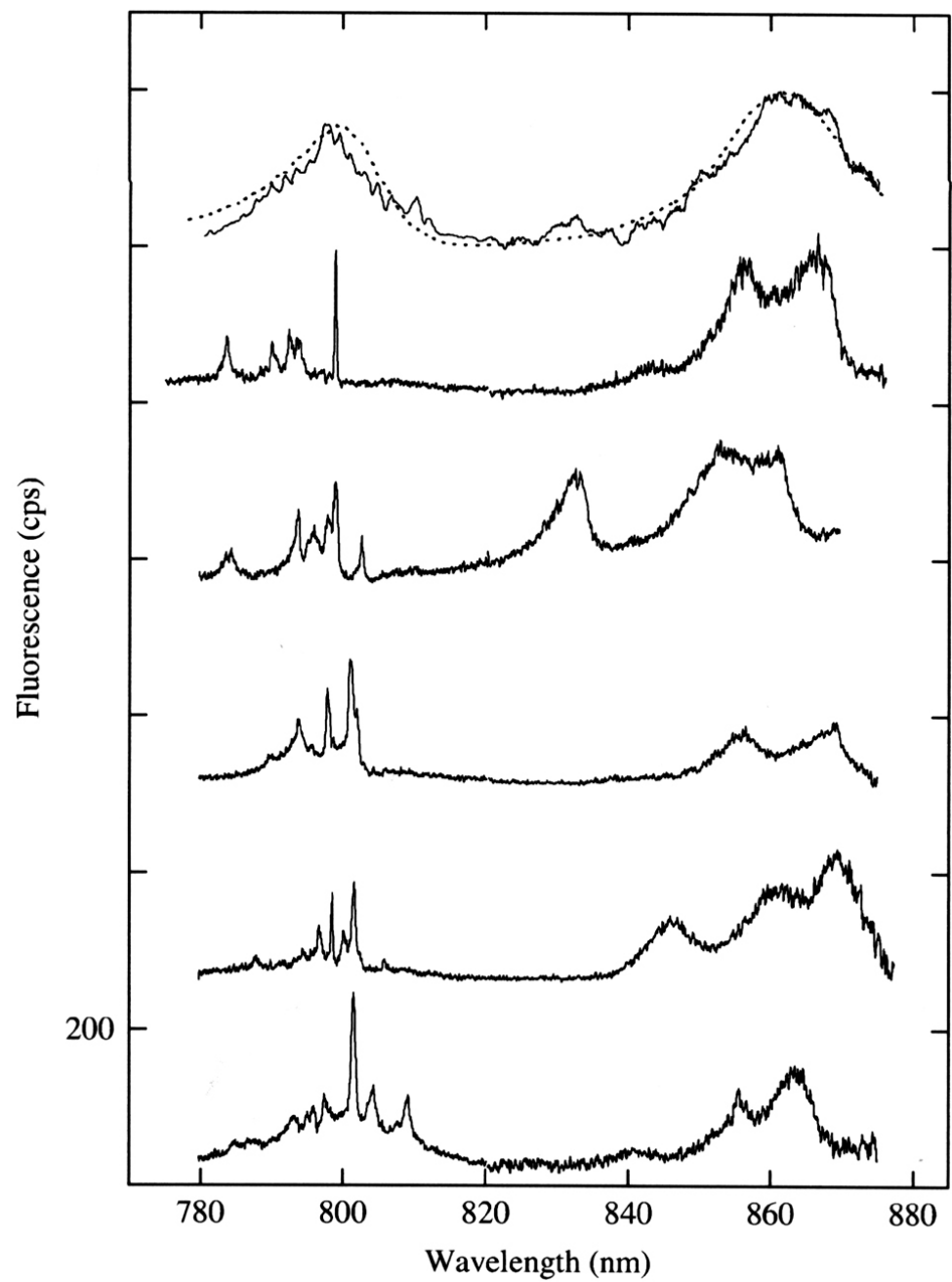




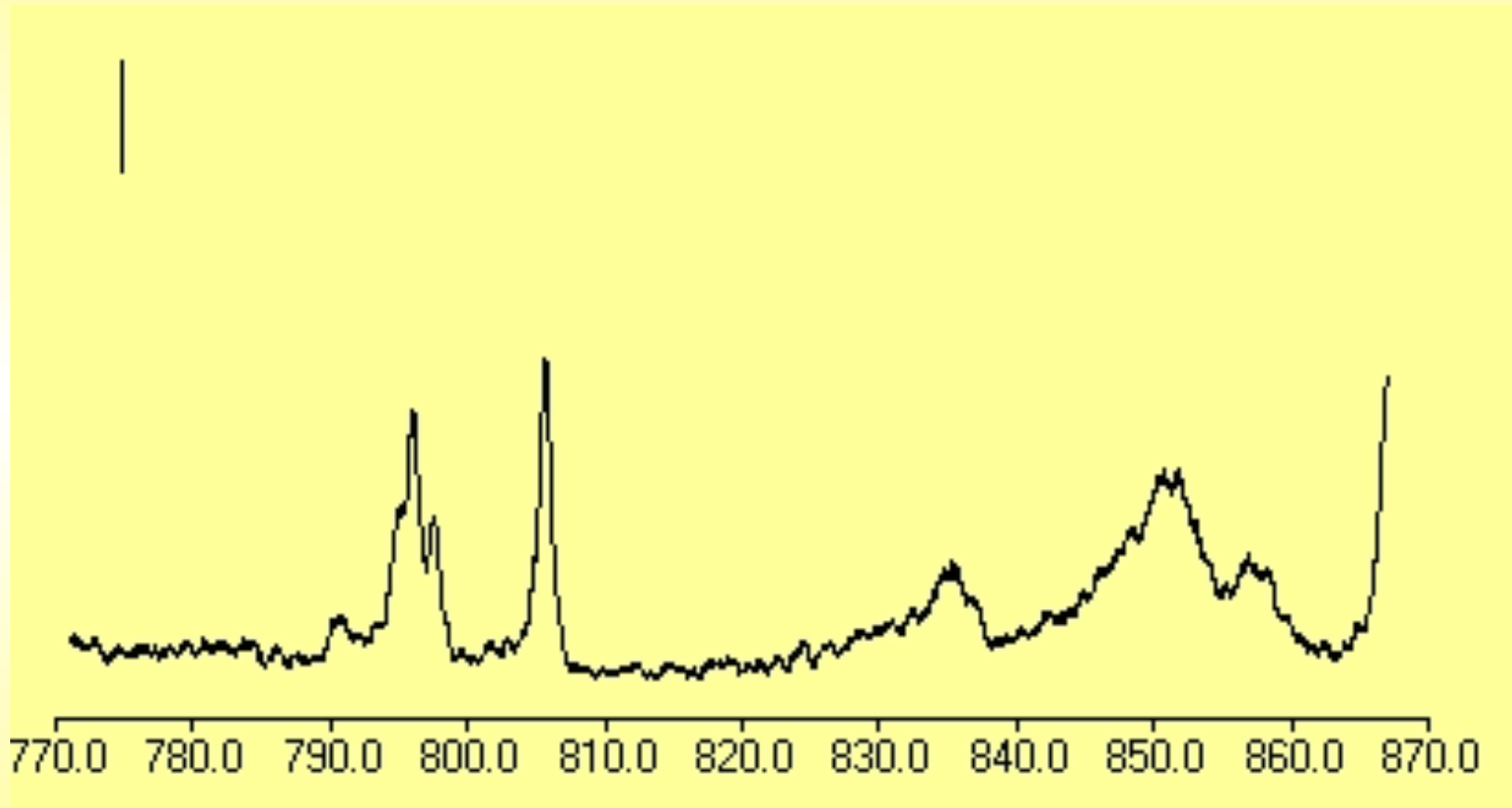


# Fluorescence emission spectrum of single LH2 molecules

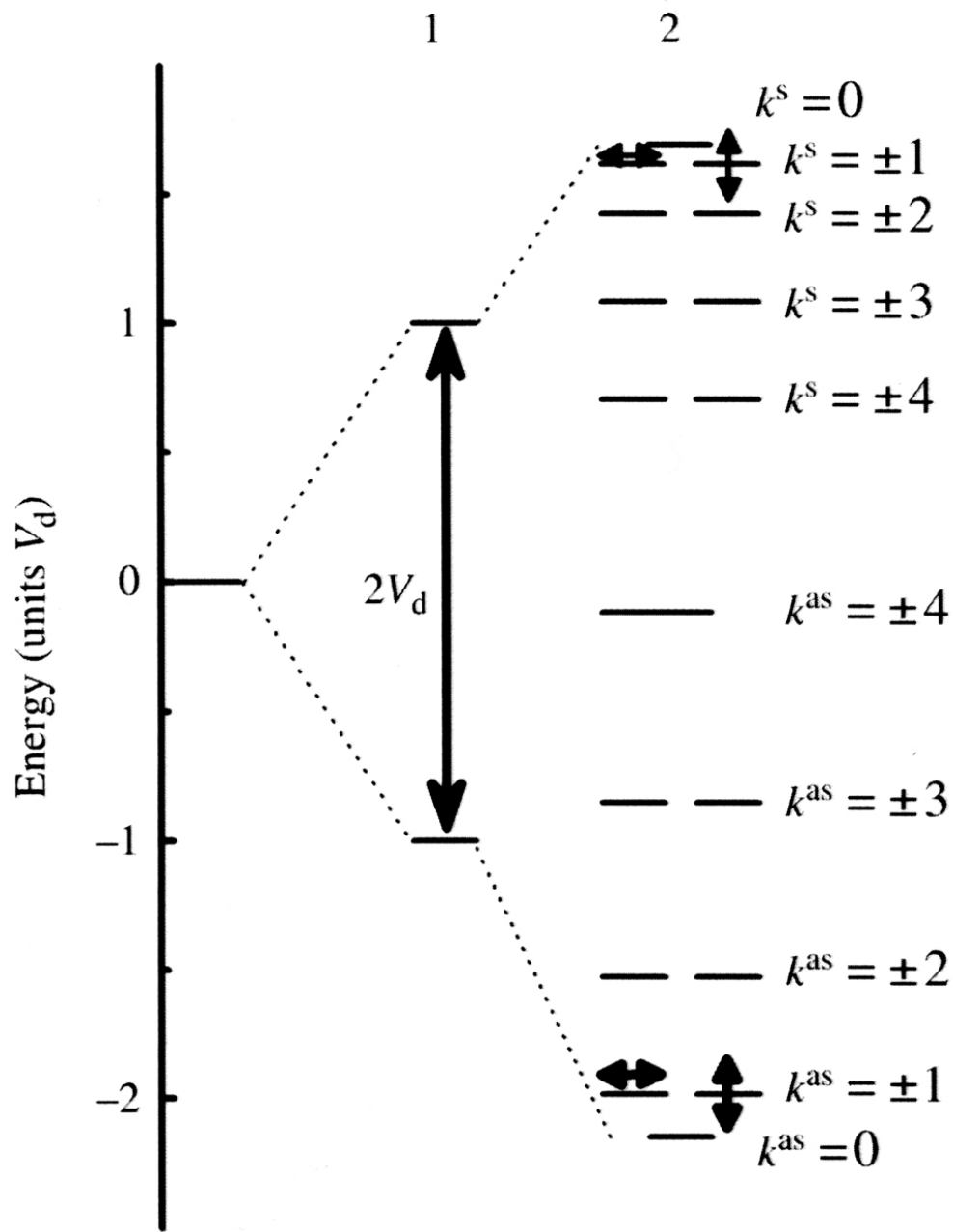


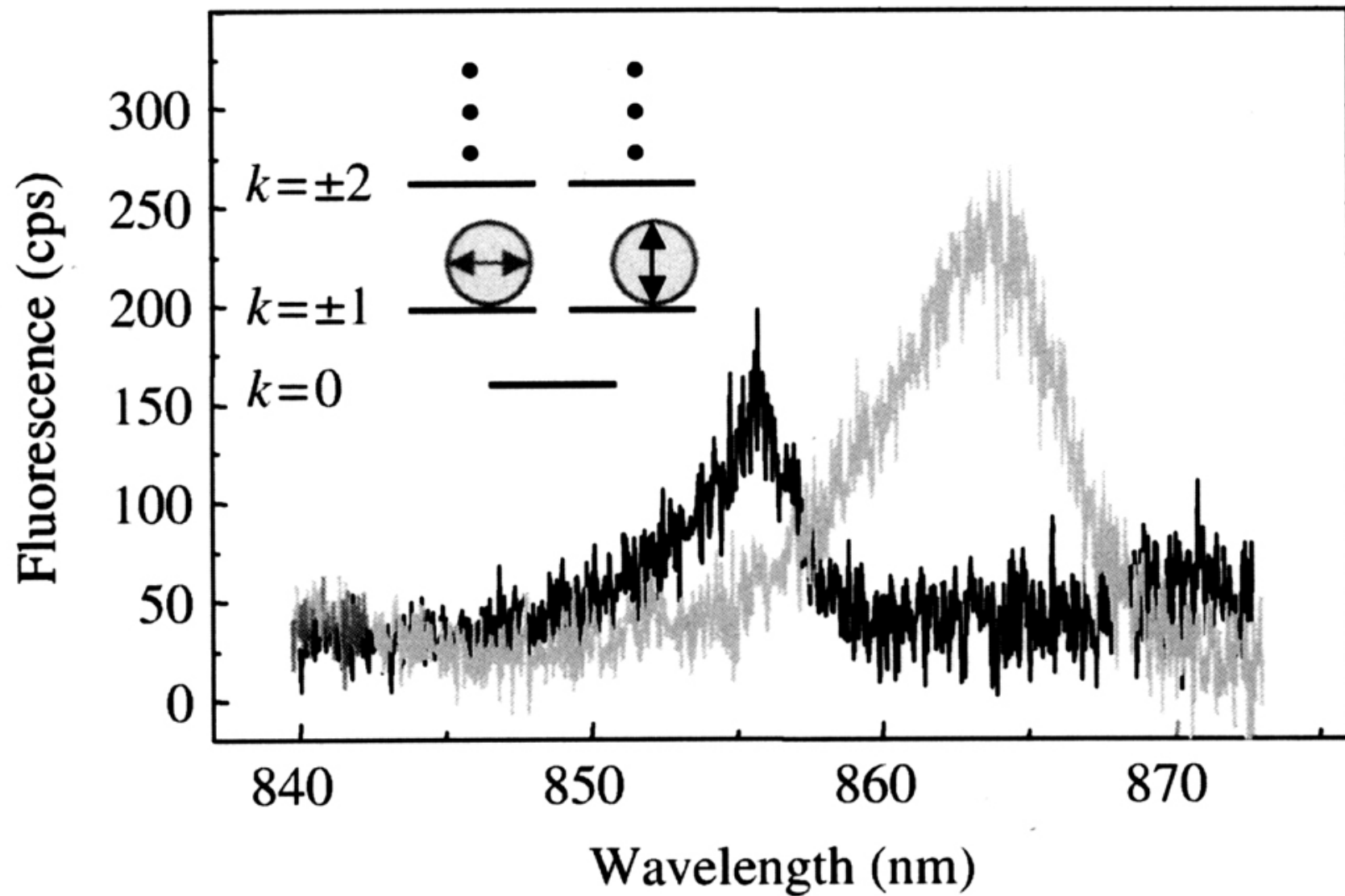


## Angular dependence of the excitation spectrum of a single LH2 complex

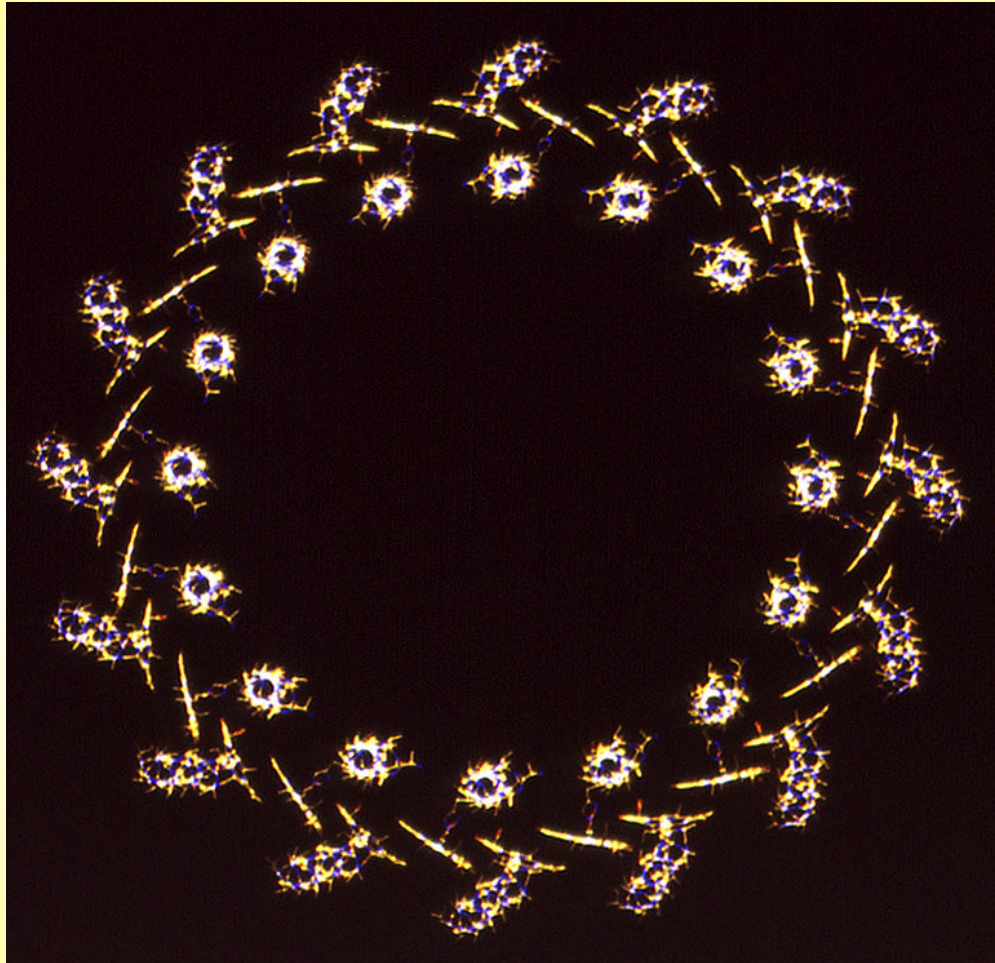




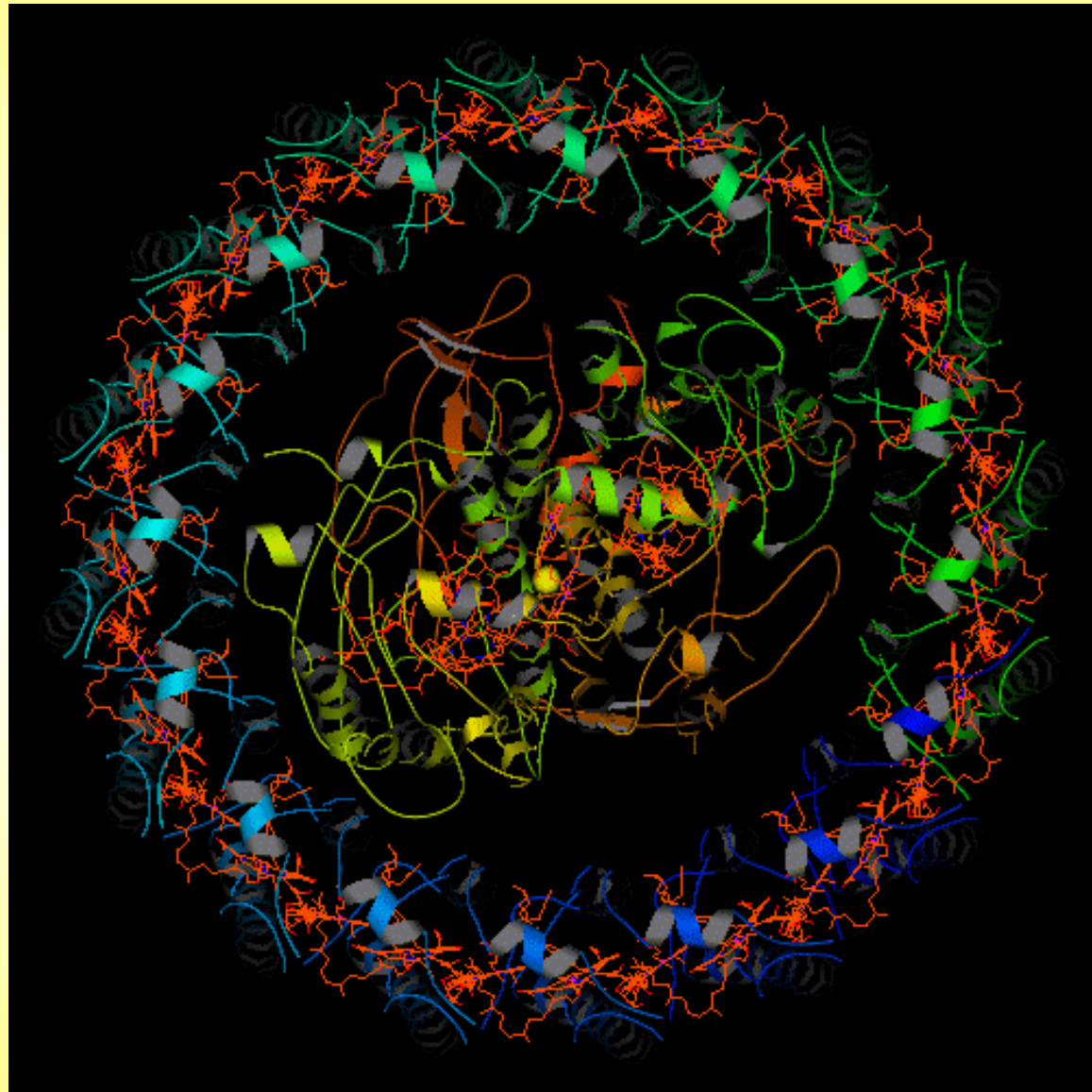




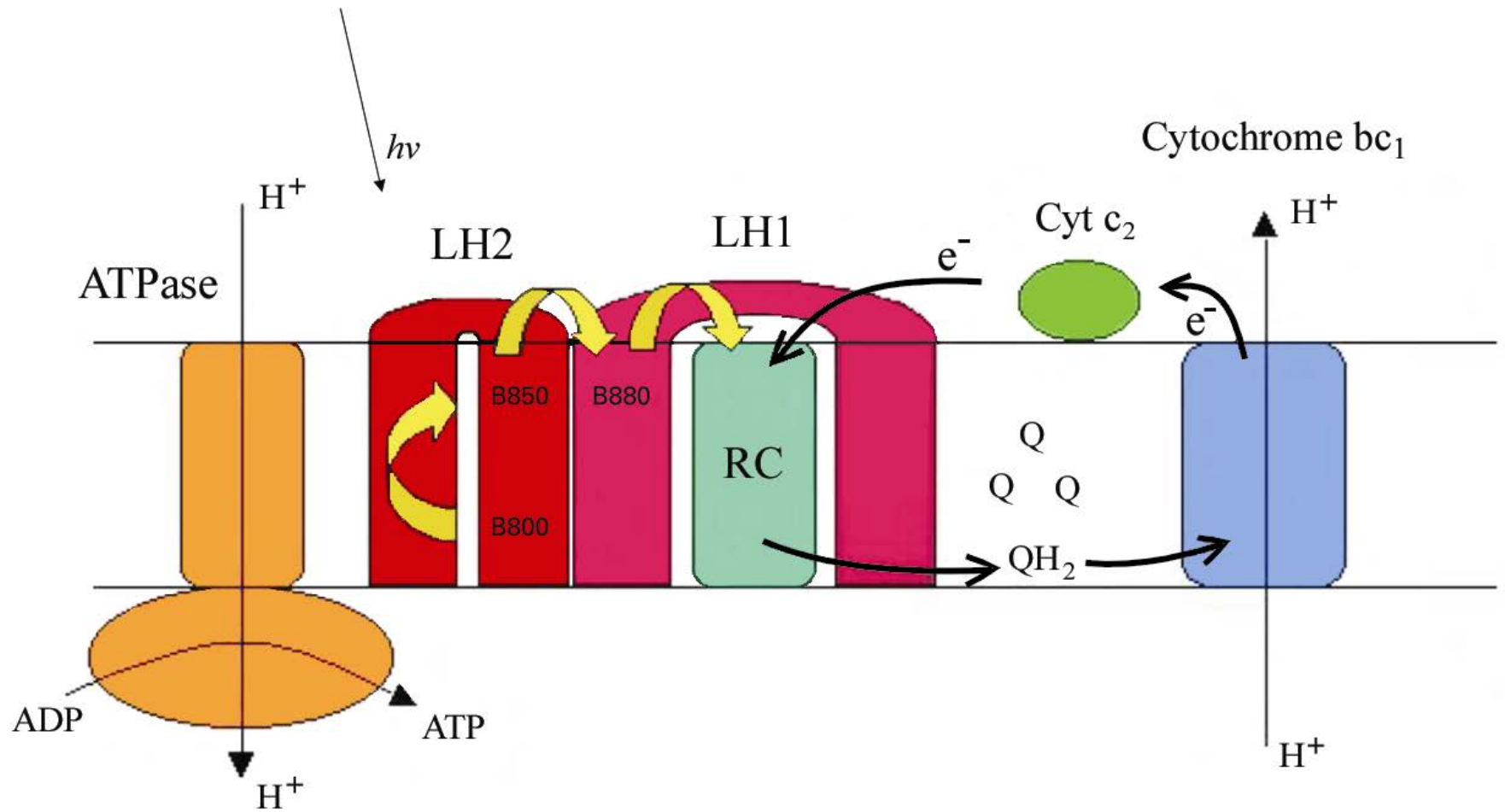
# LH1 modelled on the basis of the LH2 protomer



Taken from Karrasch et. al. (1995) EMBO J. 14: 631-638



# Photosynthetic system of purple bacteria in the ICM.

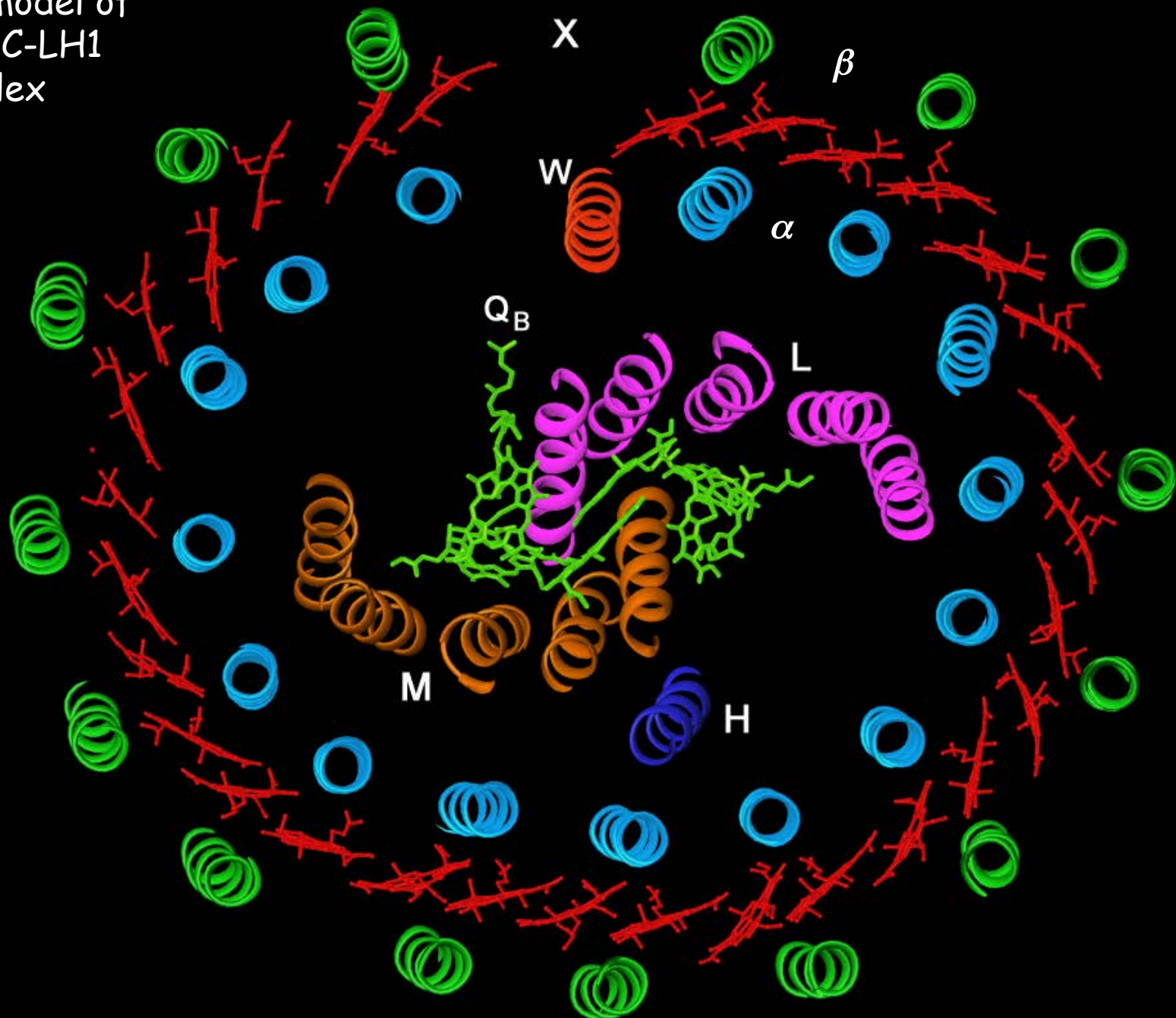


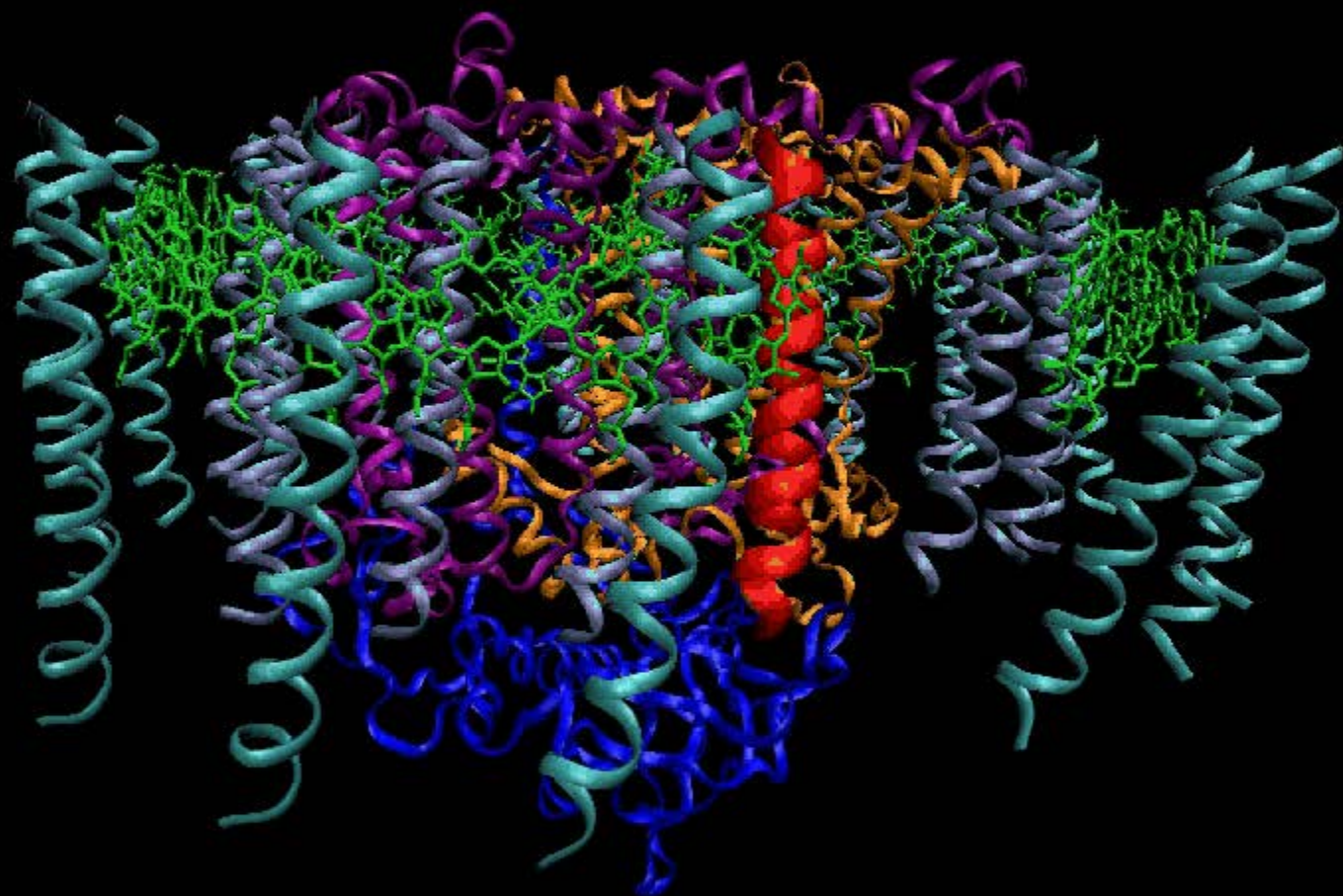


# PufX protein

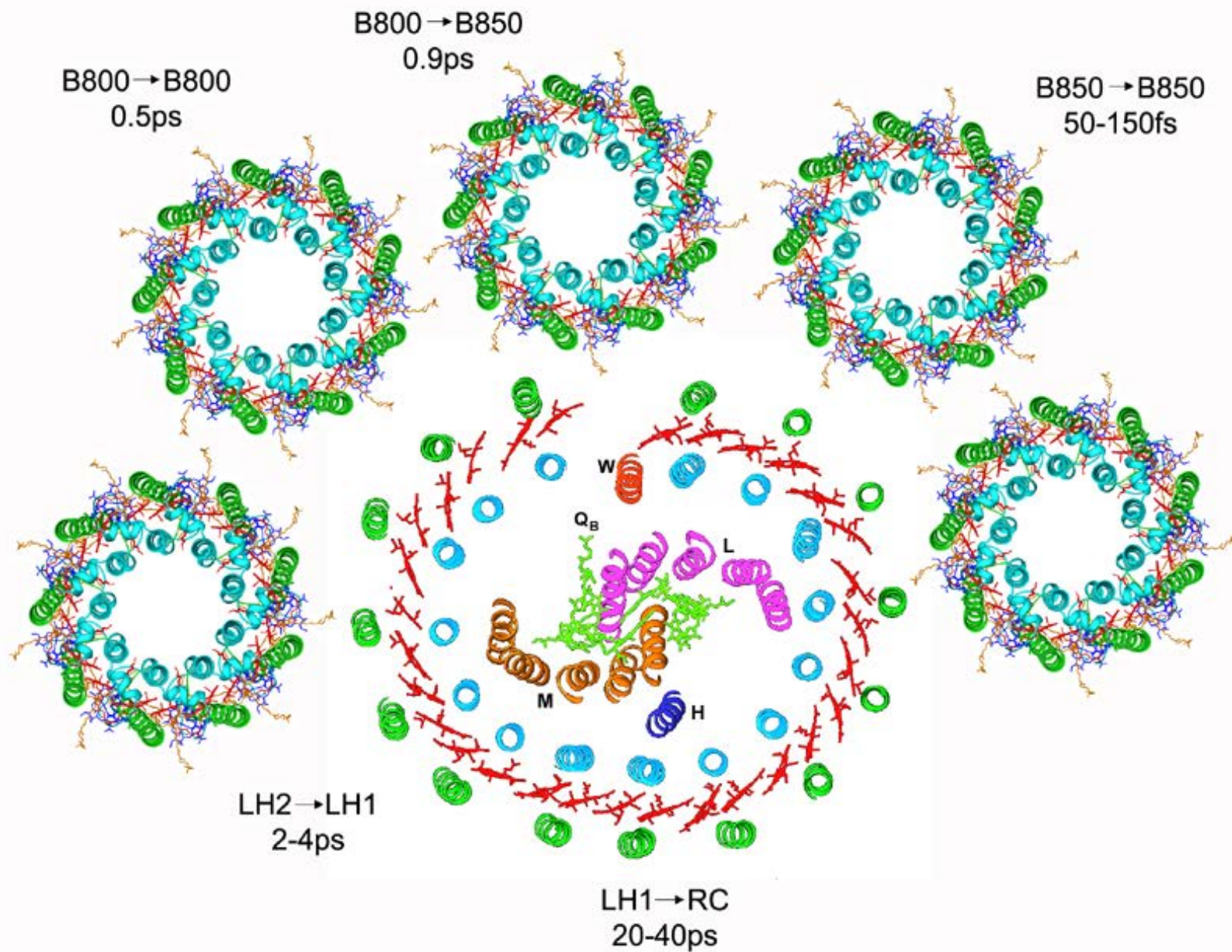
- In *Rb. sphaeroides* and *Rb. capsulatus* photosynthetic growth requires the presence of the so called **PufX** protein (70aa) which is essential to promote an efficient ubiquinone/ubiquinol exchange between the **RC** and cytochrome **bc<sub>1</sub>**.
- There is an evidence that **PufX** is involved directly in the supramolecular organization of the photosynthetic system, prevents **LH1** from completely encircling the **RC**, and perhaps induces specific orientation of the **RC** inside the **LH1** complex.
- Biochemical studies have shown that **PufX** is present in the **RC-LH1** complex in a **1:1 stoichiometry** with the **RC**, and that it has a strong tendency to interact with the **LH1**  $\alpha$ -polypeptide.
- The **EM** and **AFM** structure projections presented earlier were all obtained for reconstituted **RC-LH1** complexes without the **PufX** protein.

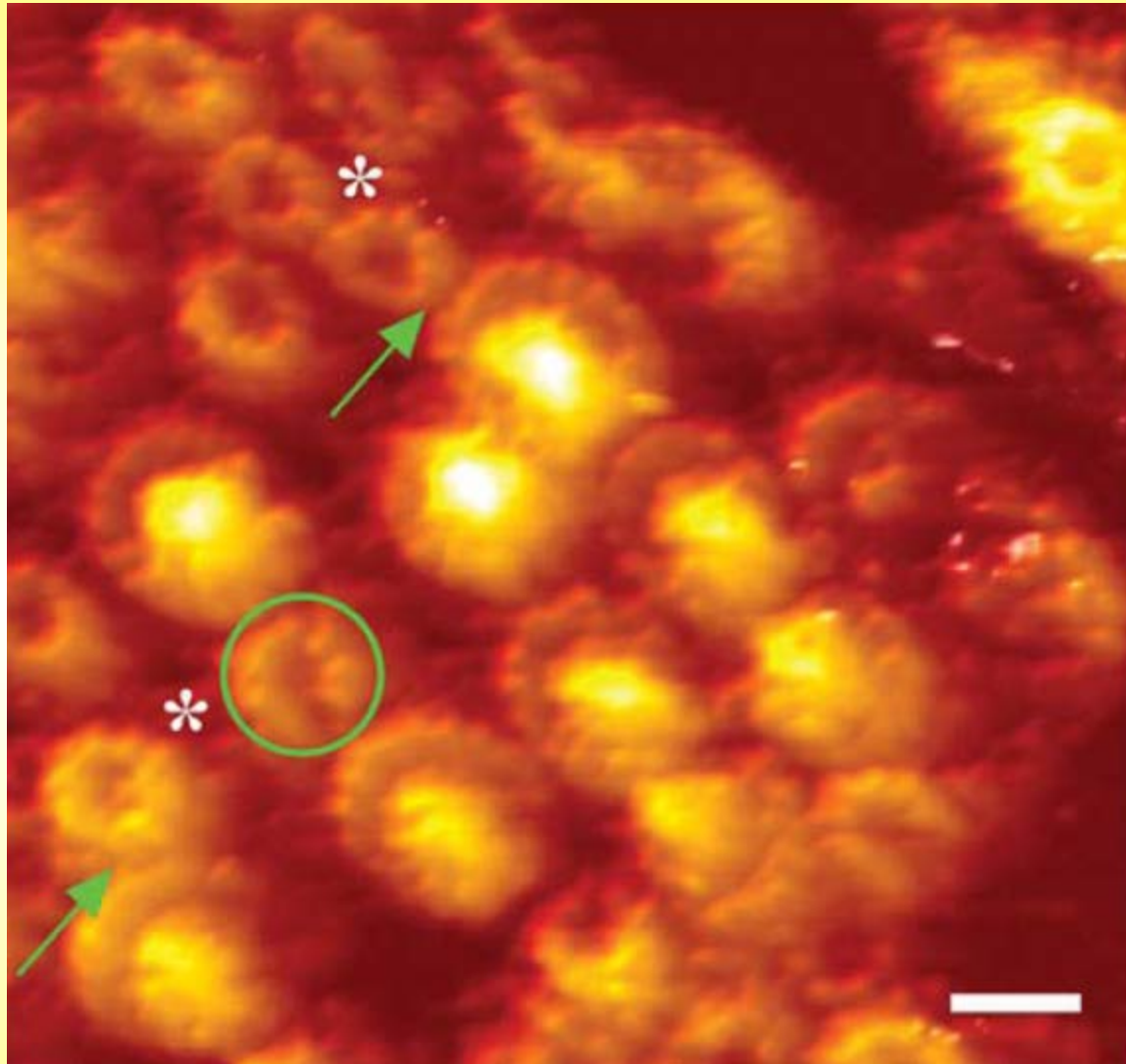
The model of  
the RC-LH1  
complex









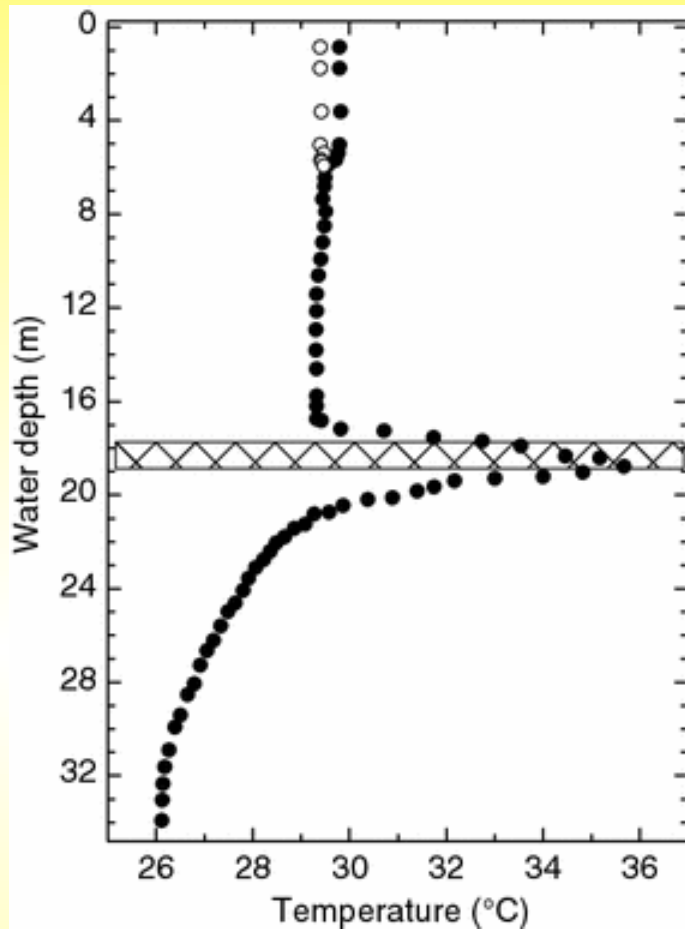


Bahatyrova, S. et al. (2004) *Nature* **430**: 1058-1062

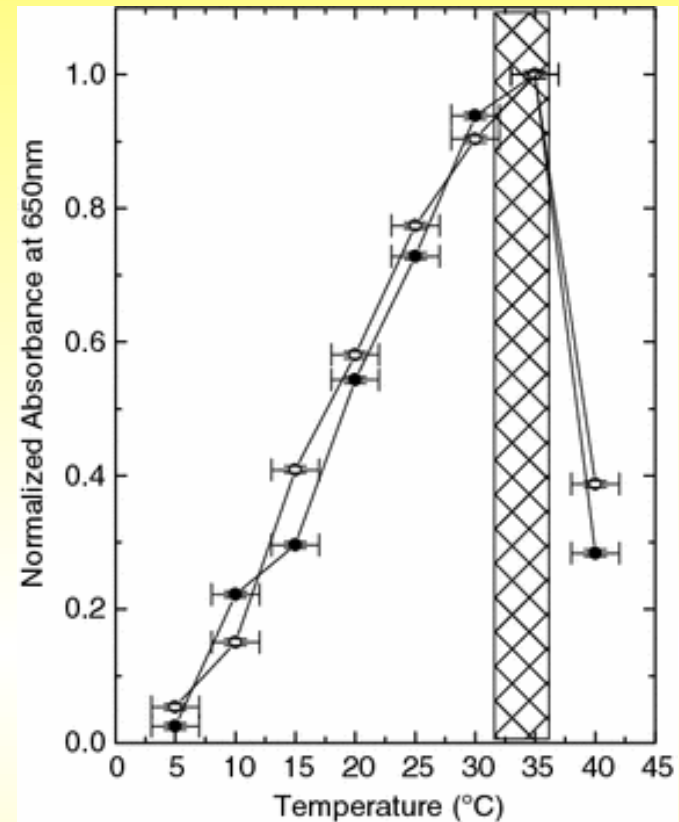


# The South Andros Black Hole cave system (Bahamas)





Day-time (*solid circles*) and night-time (*open circles*) temperature profiles of the water column and spatial location (hatched horizontal bar) of the phototropic purple sulphur bacteria



Growth temperature profiles of isolates *Thiocapsa* BH-1 (*closed circles*) and *Allochromatium* BH-2 (*open circles*). For clarity, the data has been normalized to the maximum absorbance value for each bacterium. The hatched vertical bar represents the in situ temperature domain where the phototropic purple sulphur bacteria are located in the natural water column,