



# SPECTROSCOPY OF PHOTOSYNTHETIC PIGMENT-PROTEIN COMPLEX LHCI

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# our Team



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Rafał Luchowski



Małgosia Gospodarek



Wojtek Grudziński



Ignacy Gryczynski



Karol Gryczynski





## Outline:

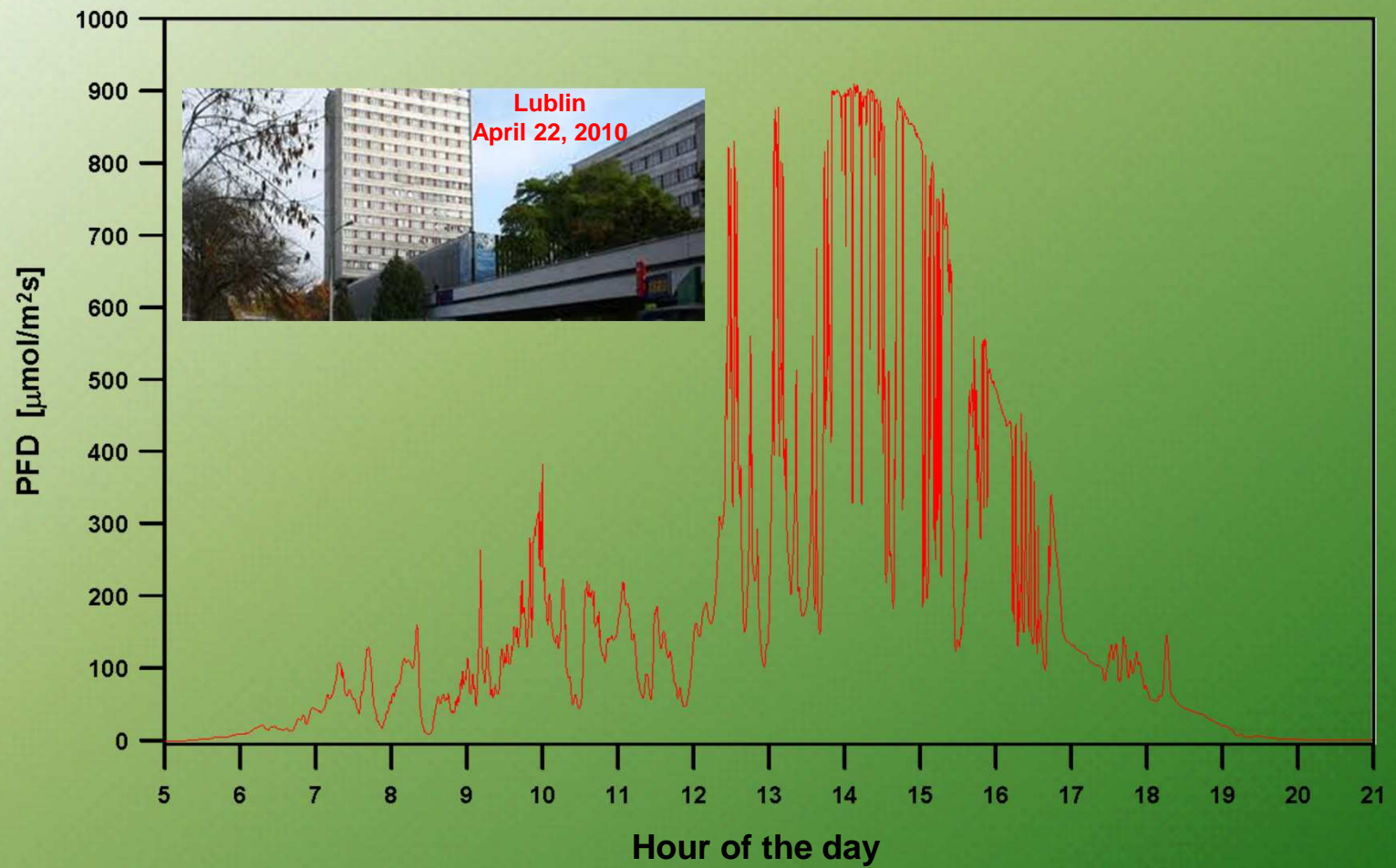
1. What is LHCII?
2. Why study LHCII?
3. Spectroscopy of LHCII



# Photodegradation



# Illumination during a day



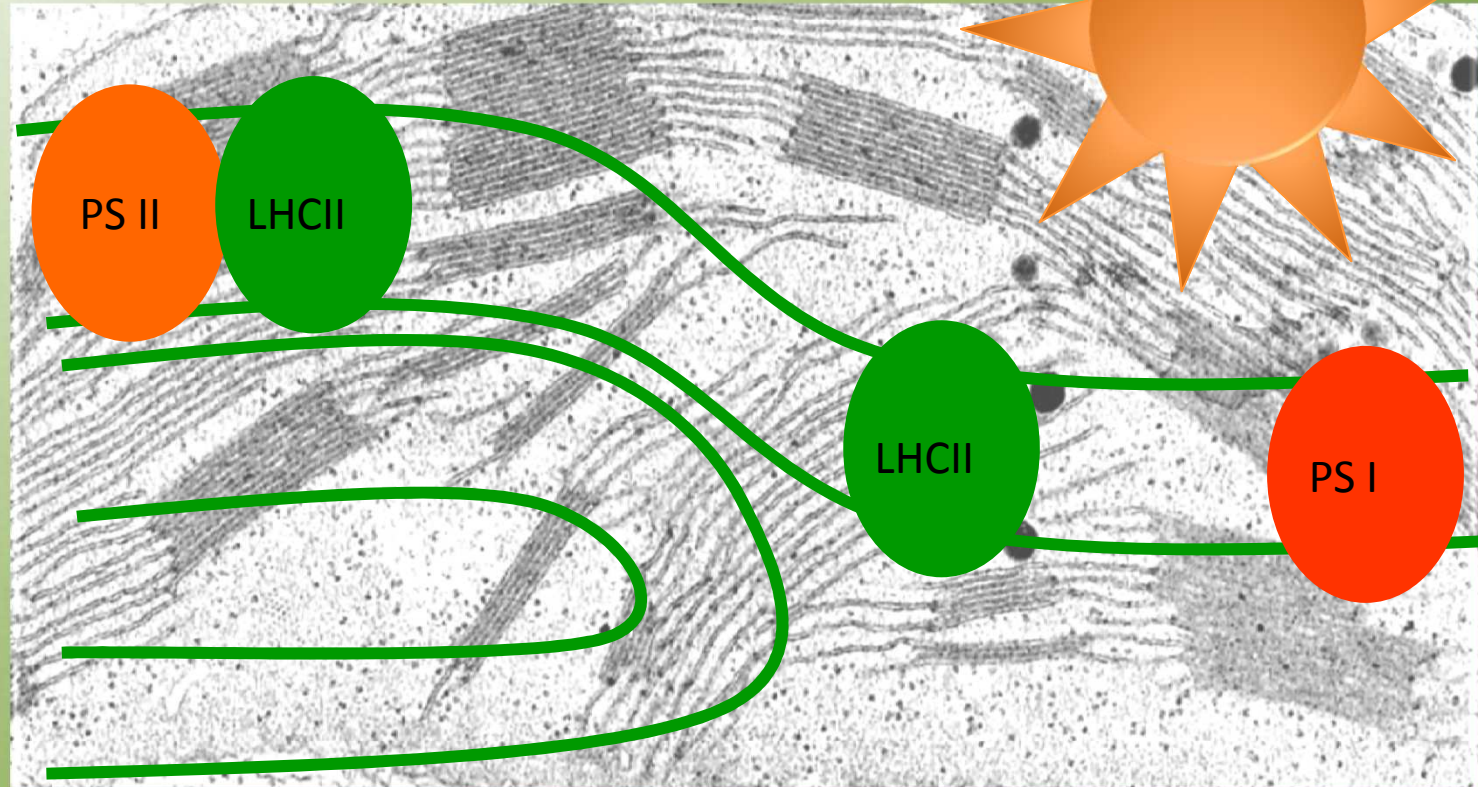
# Whole plants



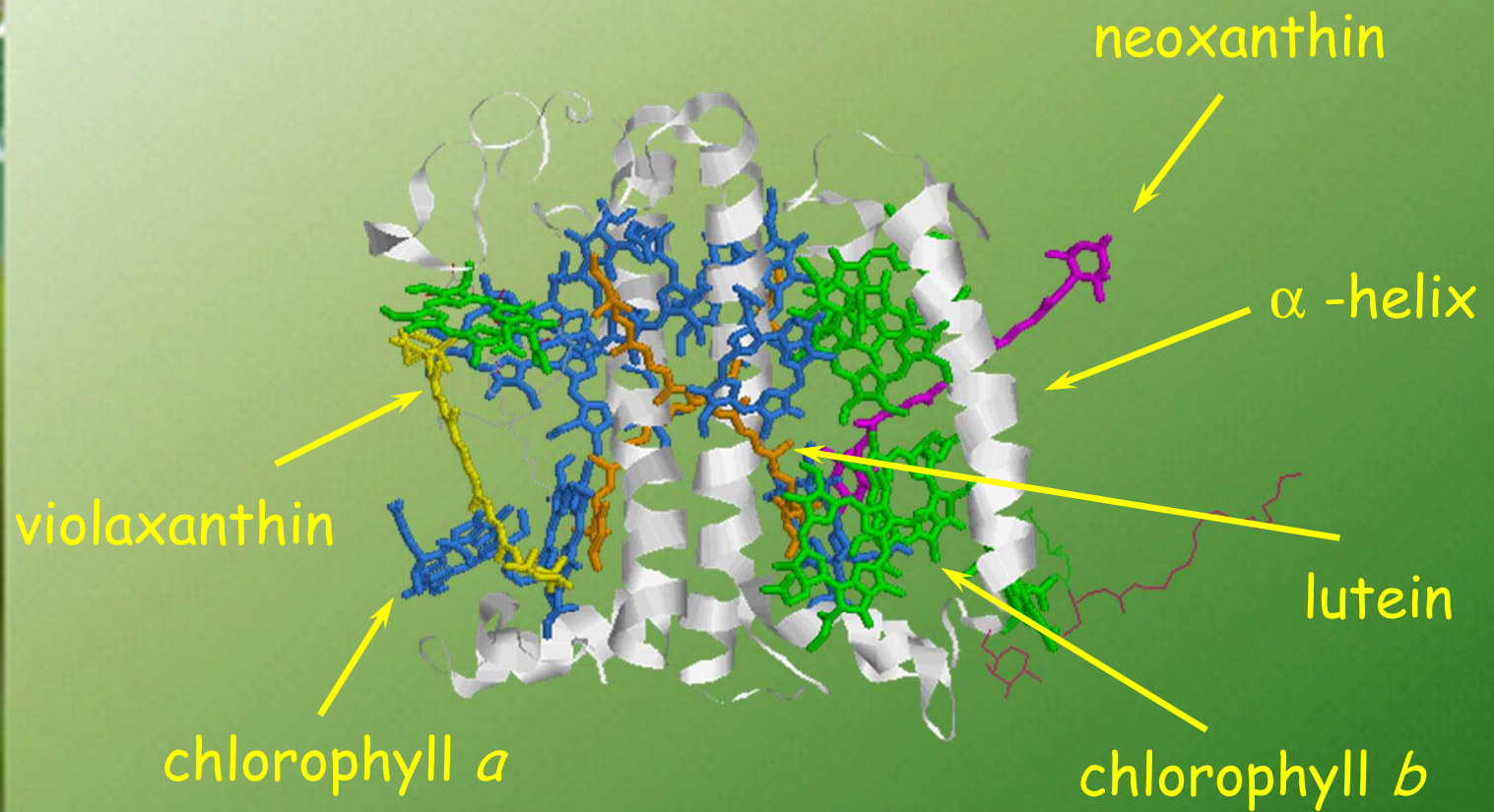
*Oxalis oregana*



# State I - State II transition



# antenna complex LHCII



according to Z. Liu et al., Nature 428 (2004) 287-292.



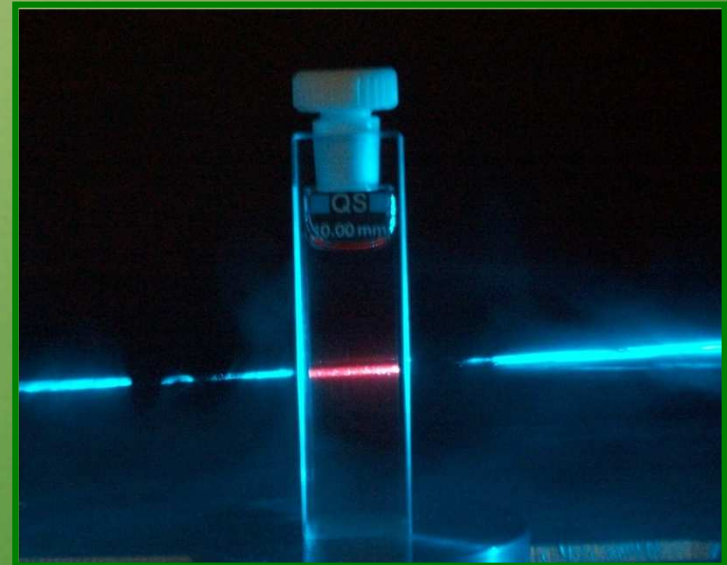
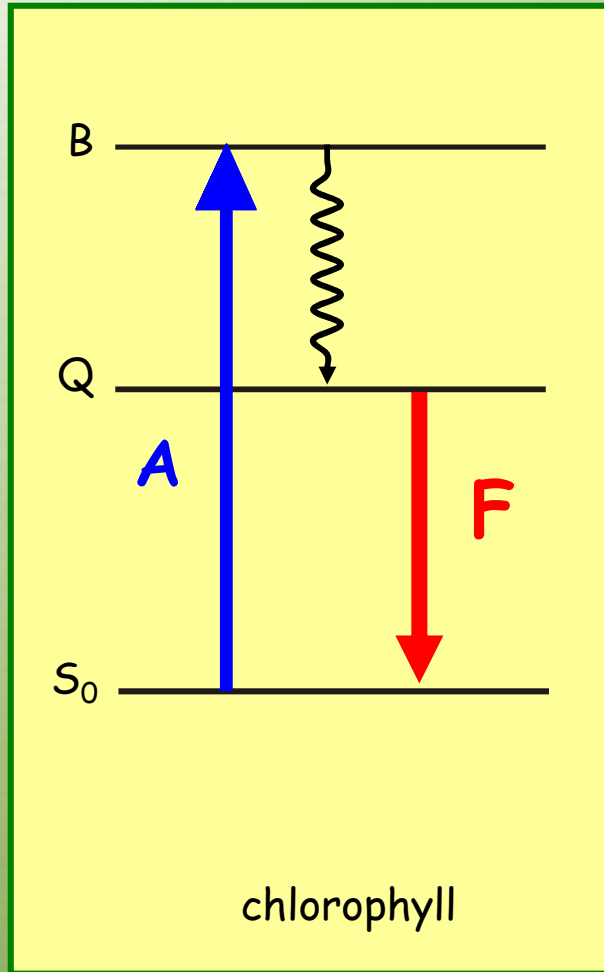


# Excitation quenching

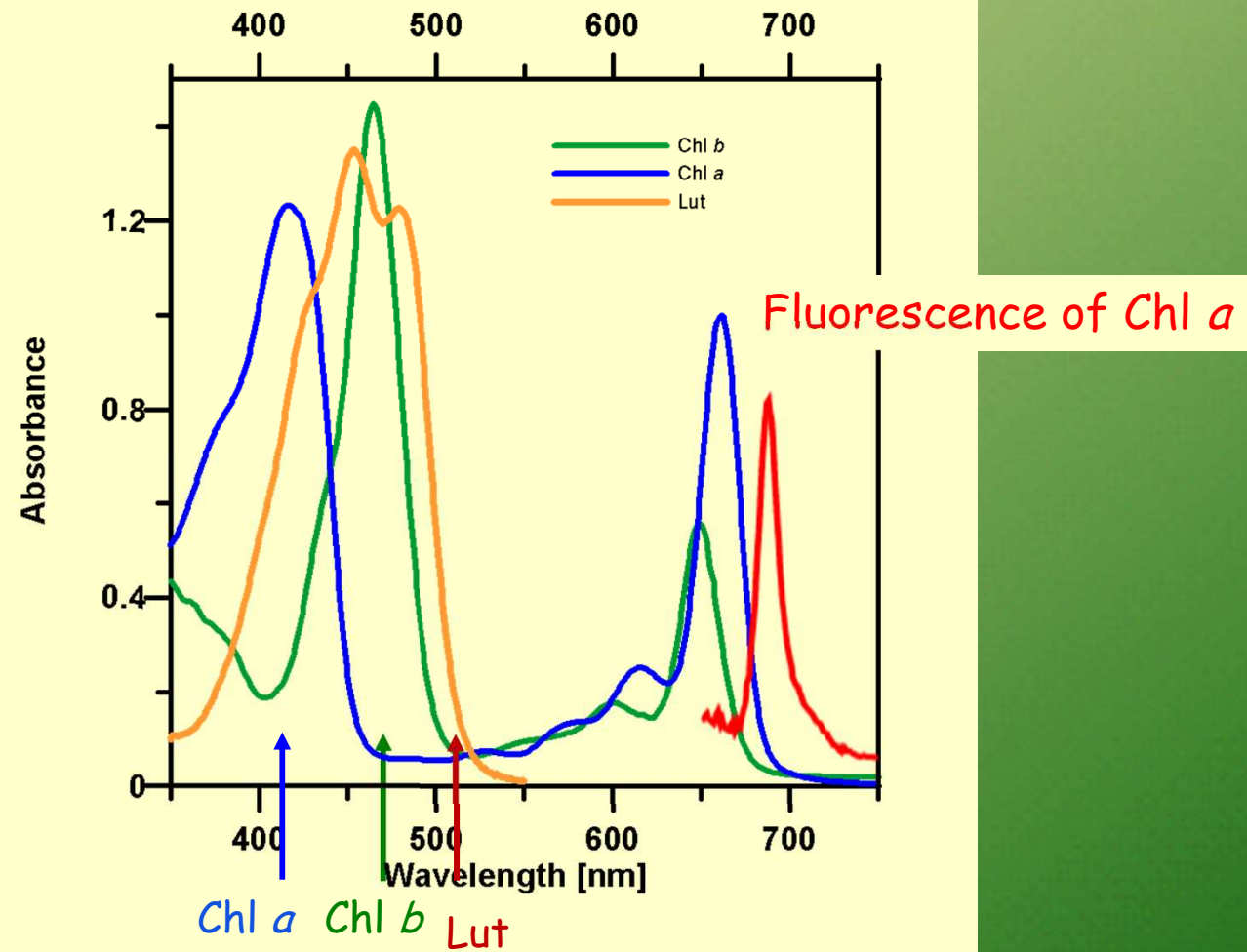
Fluorescence spectroscopy of  
LHCII



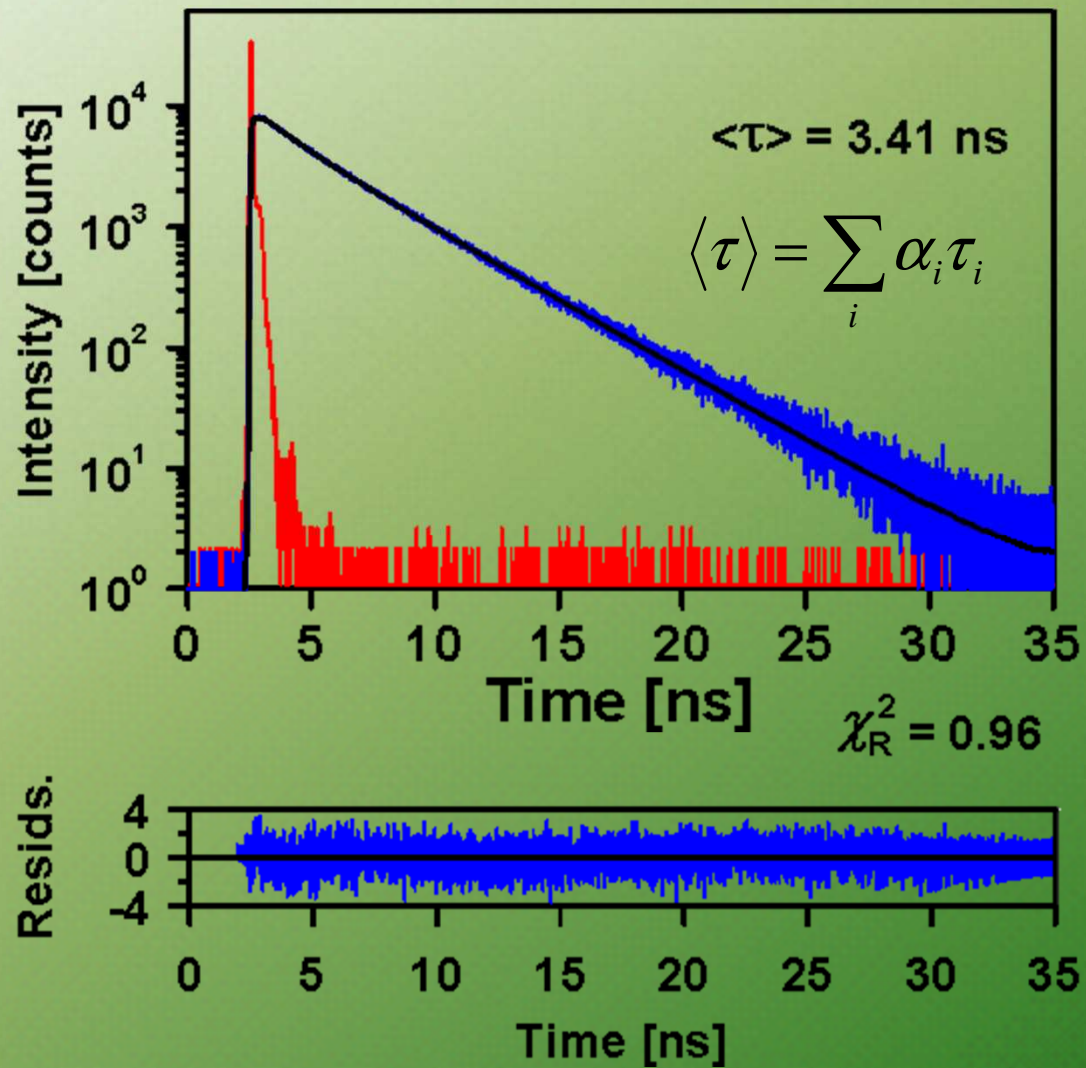
# Fluorescence of chlorophyll *a*



## Absorption spectra of pigments bound to LHCII



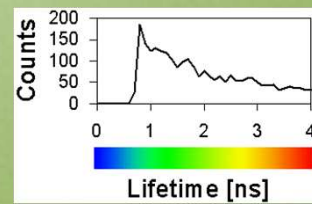
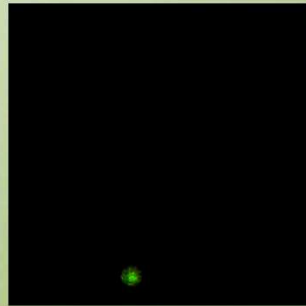
# Fluorescence lifetime chlorophyll *a* in LHCII



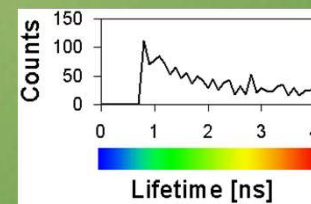
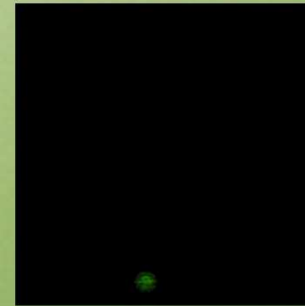
# FLIM

single molecule of LHCII

Ex 470 nm

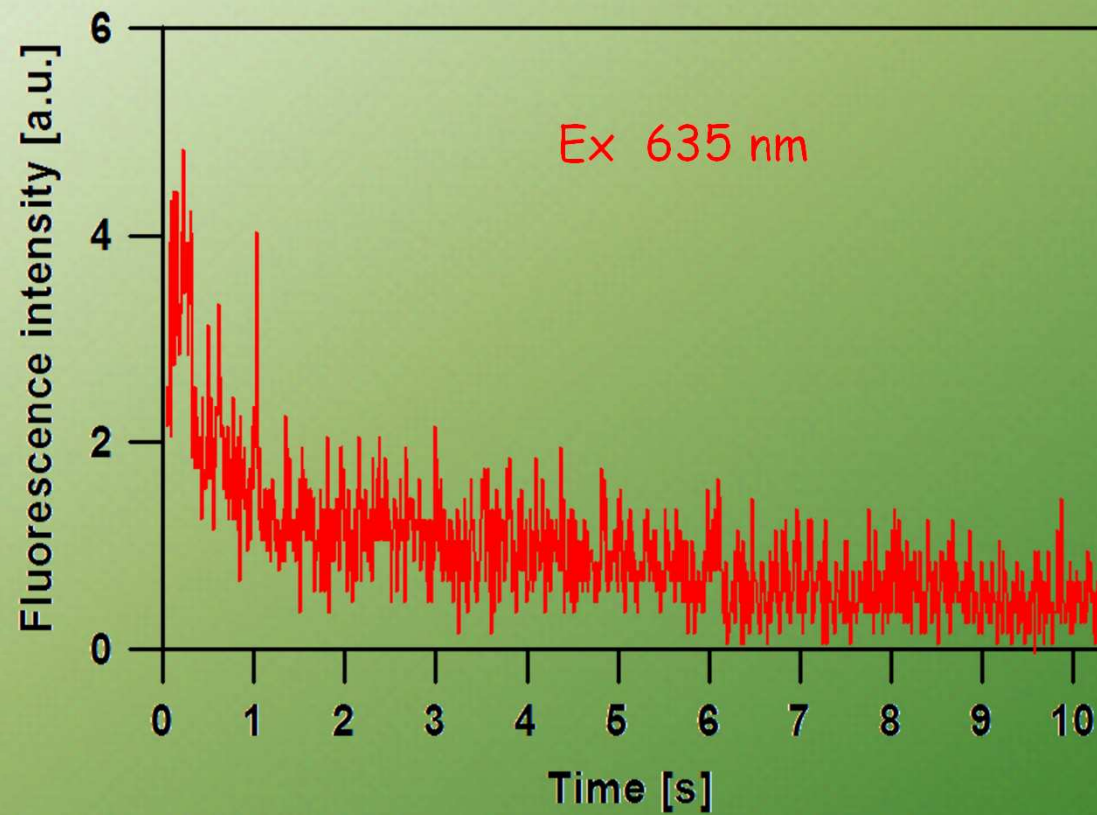


Ex 635 nm



# FLIM

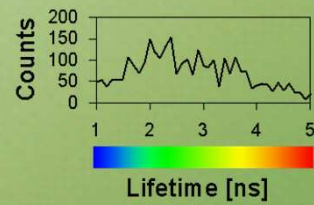
single molecule of LHCII



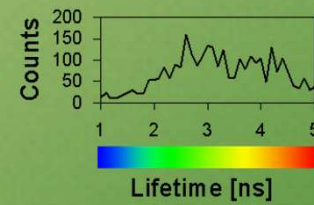
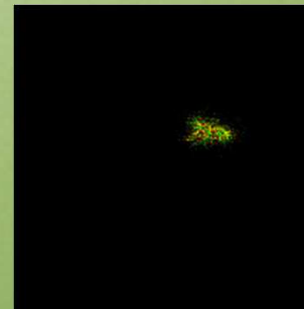
# FLIM

single LHCII trimer

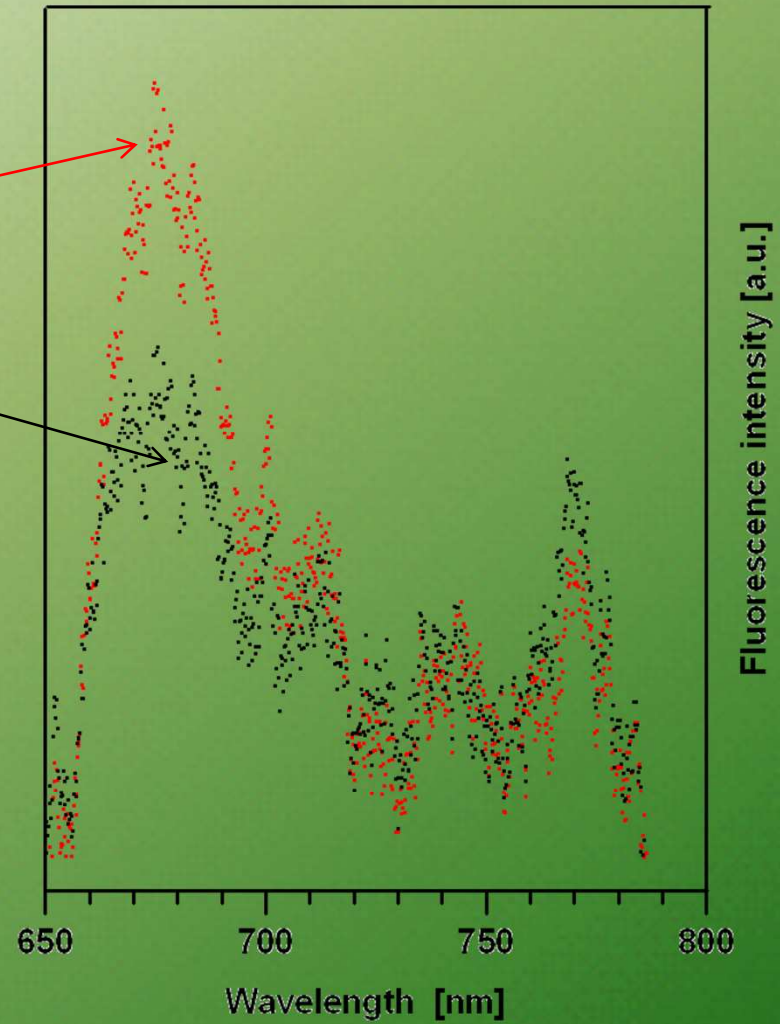
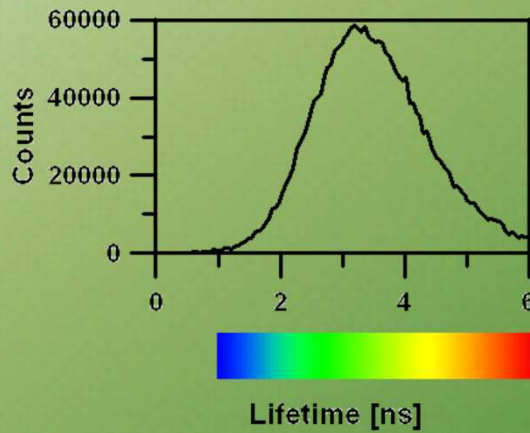
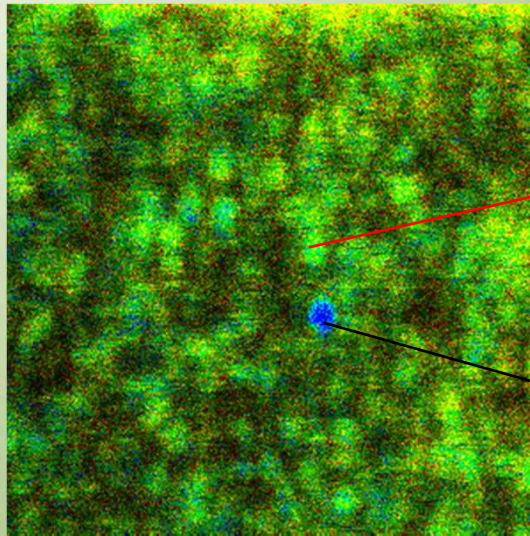
Ex 470 nm



Ex 635 nm

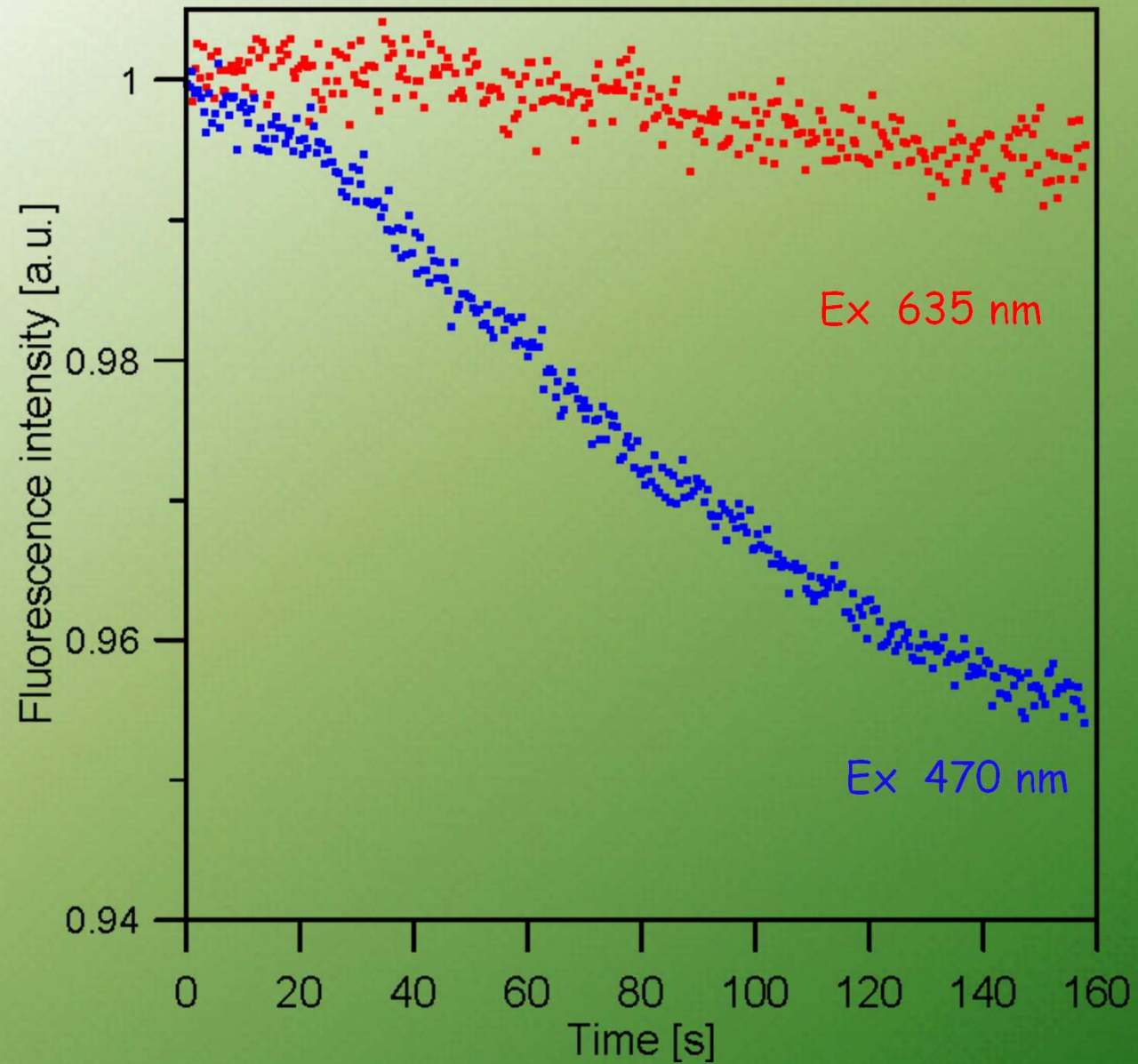


# Fluorescence spectra of single LHCII particles





# Fluorescence LHCII

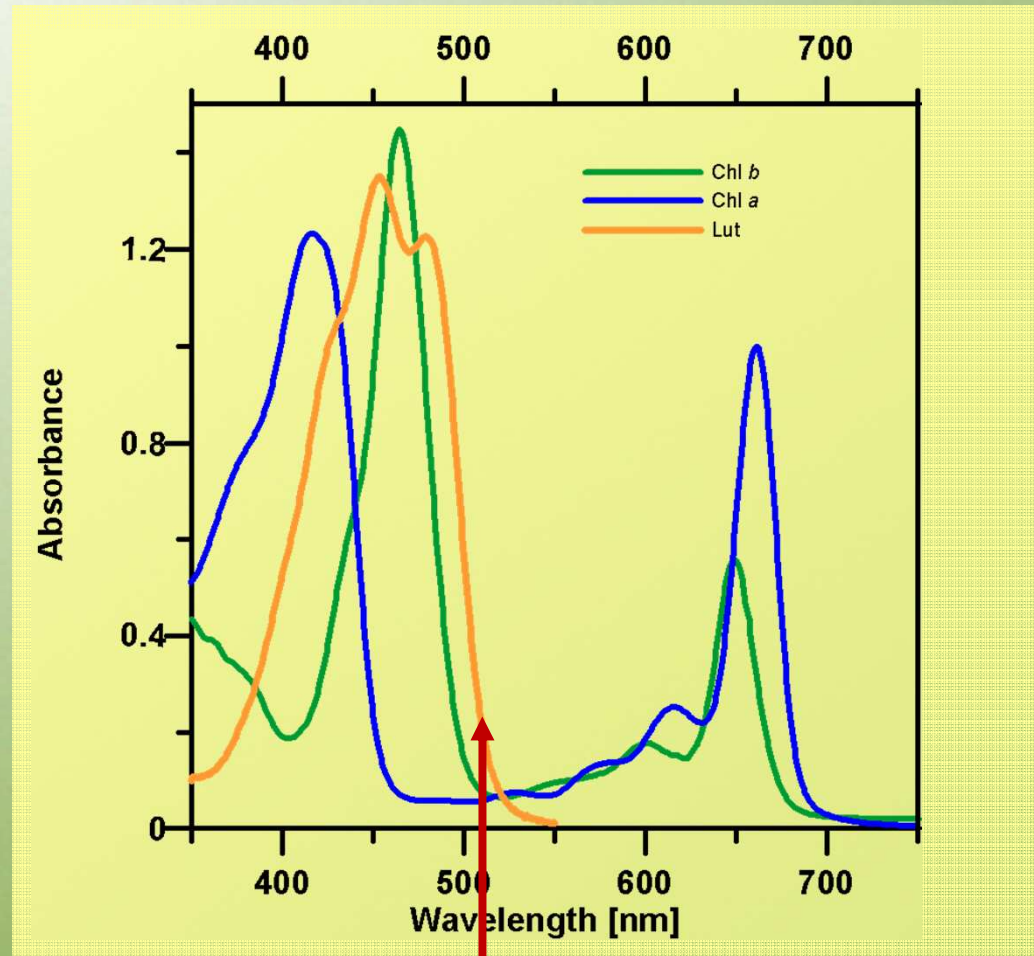


# Molecular mechanisms

## Raman spectroscopy of LHCII



# Pigment absorption spectra



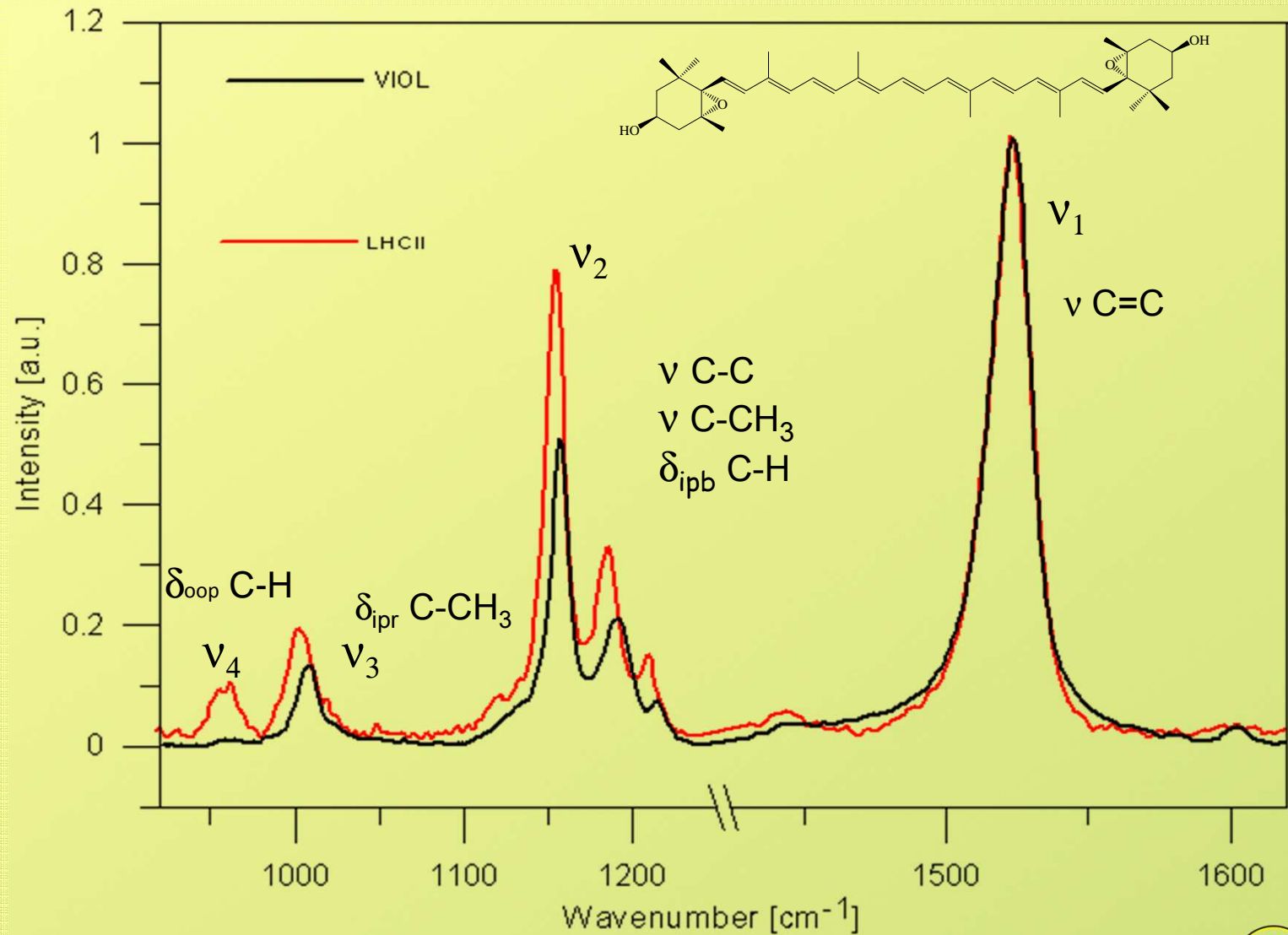
Neoxanthin 488 nm \*  
Violaxanthin 492 nm  
Lutein 489 nm  
Lutein 495 nm

Argon Laser  
514.5 nm

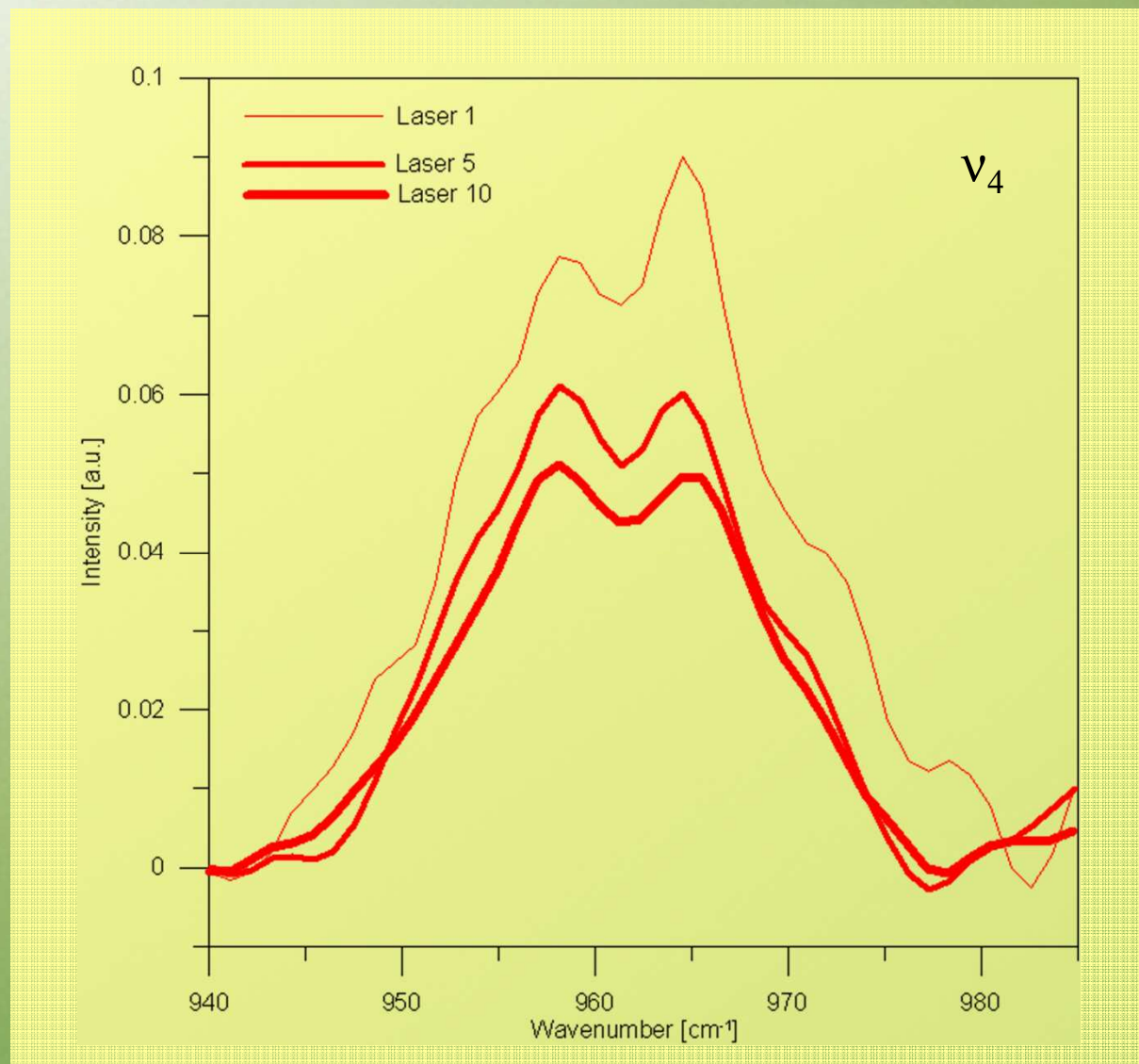
\* according to R. Croce et al., Photosynth. Res. 64 (2000) 221-231.



# Raman spectra of carotenoids



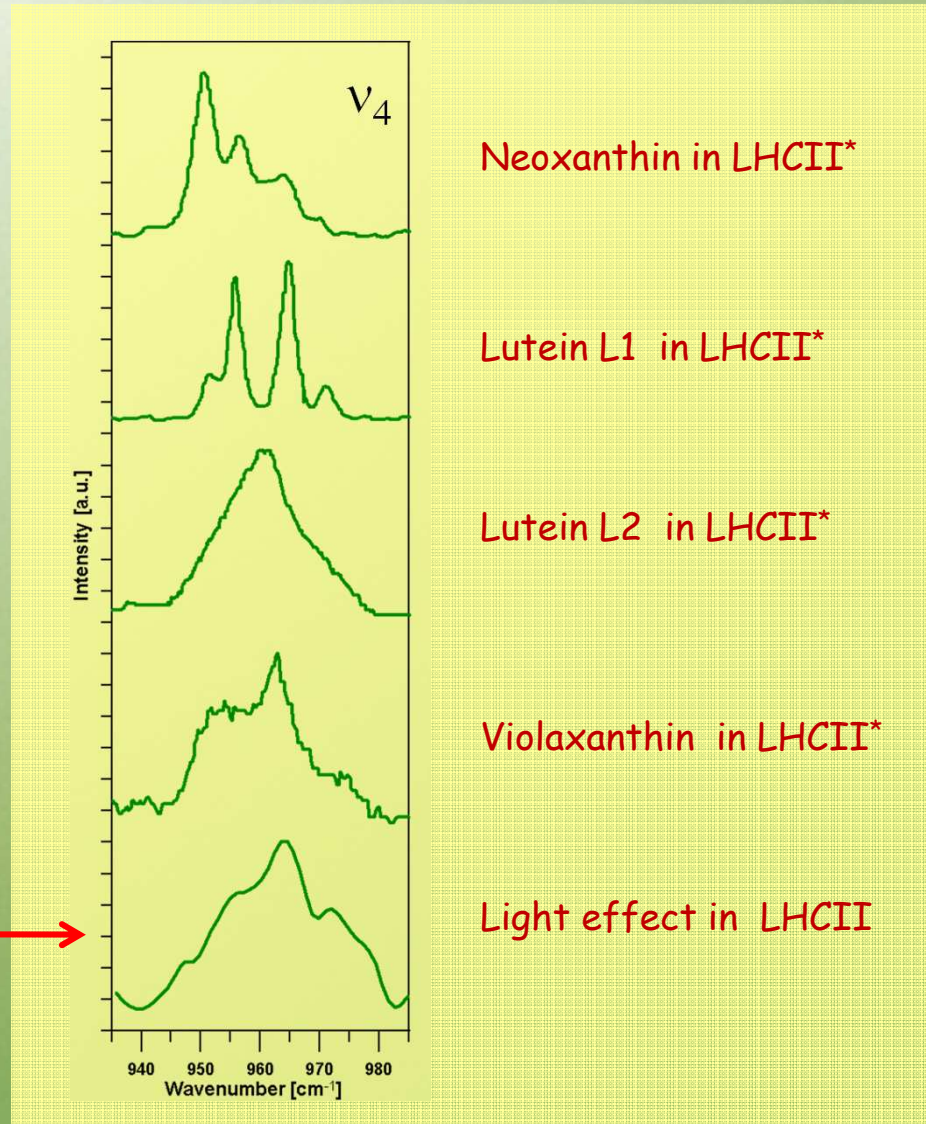
## Effect of light intensity



W.I. Gruszecki et al., *J. Phys. Chem. B* 113 (2009) 2506-2512.



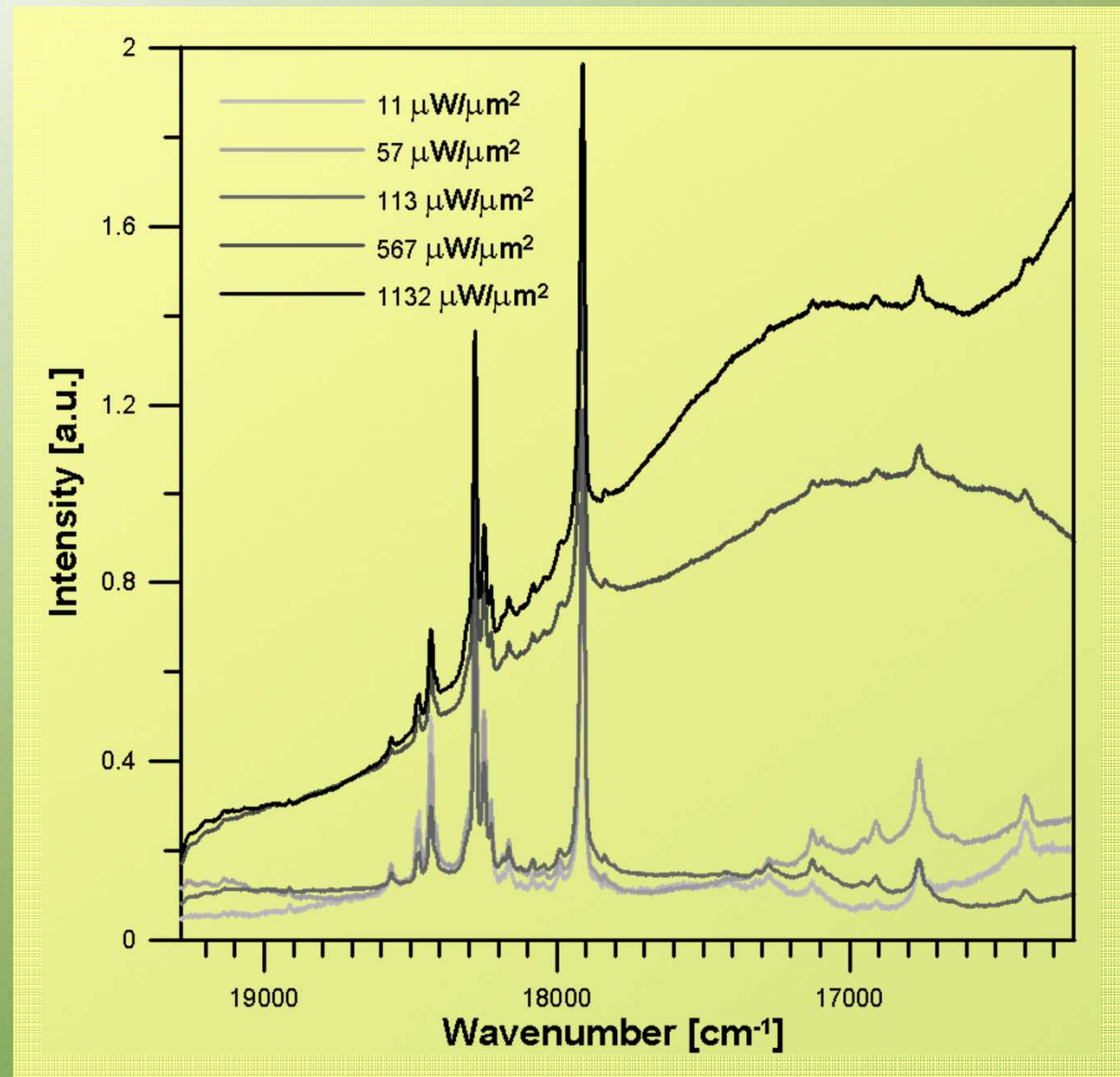
# Light effect on LHCII



\* according to A.V. Ruban et al., JBC 277 (2002) 42937-42942.



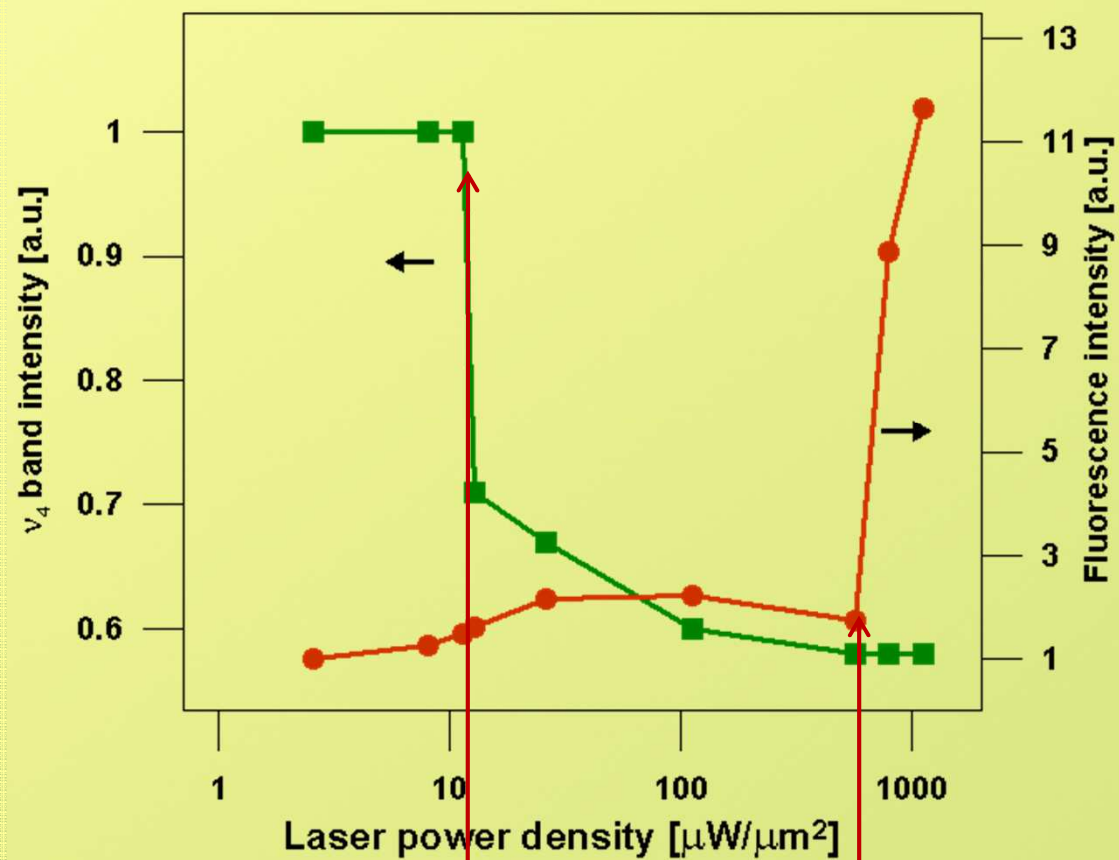
## Carotenoid fluorescence in LHCII



W.I. Gruszecki et al., *J. Phys. Chem. B* 113 (2009) 2506-2512.

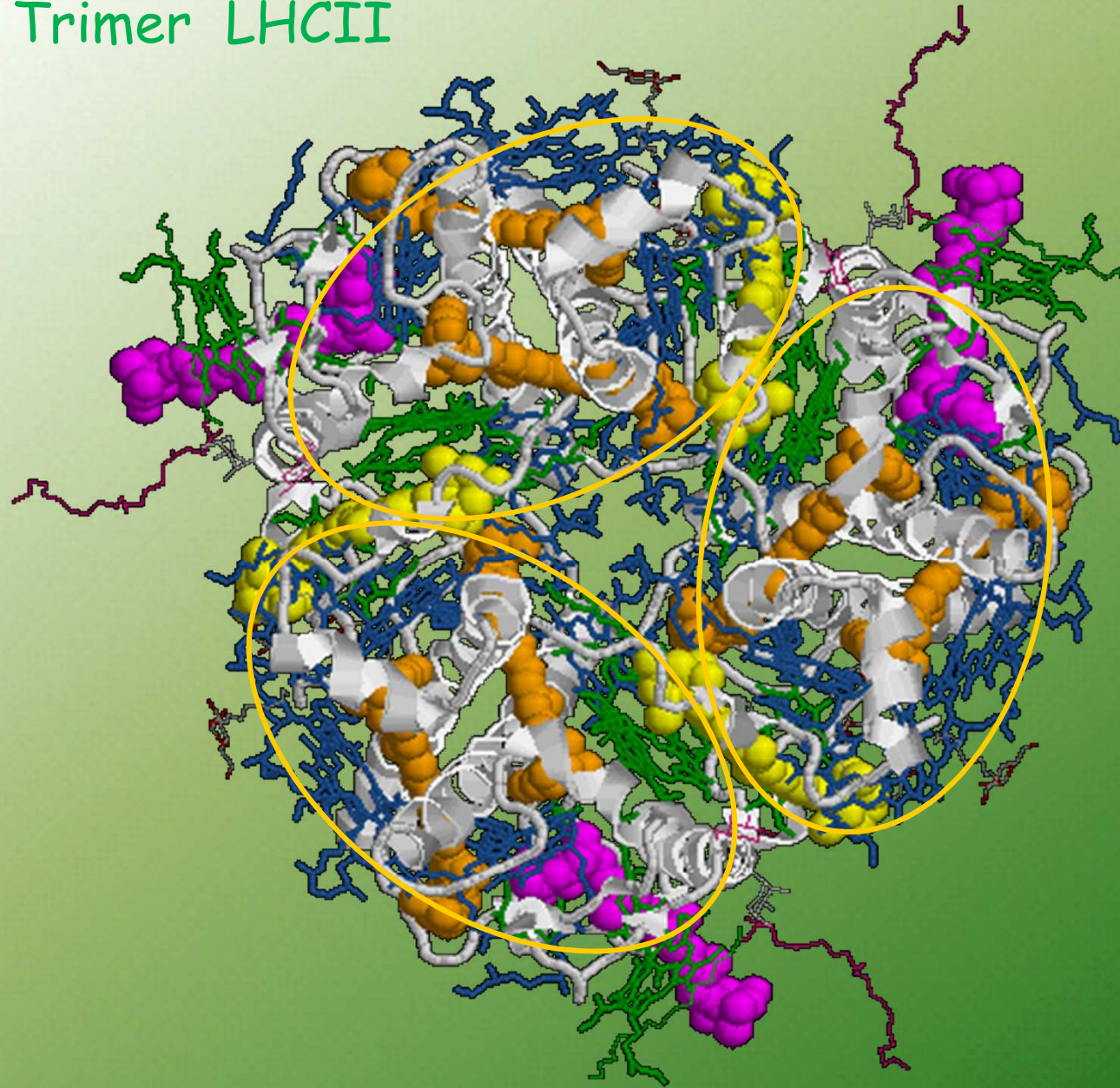


## Effect of light intensity





## Trimer LHCII



according to Z. Liu et al., Nature 428 (2004) 287-292



# LHCII

Photo-transformation

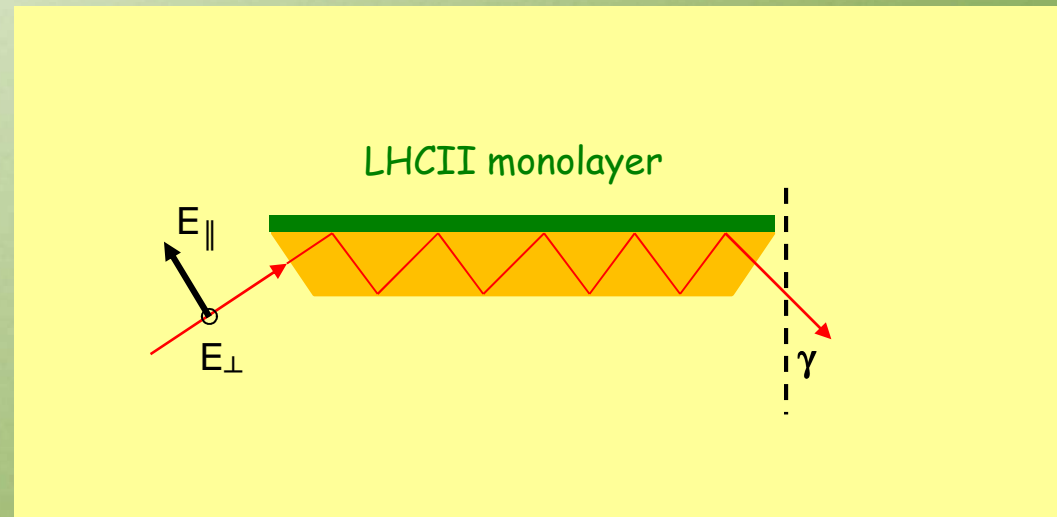


# Molecular mechanisms

FTIR spectroscopy  
of LHCII

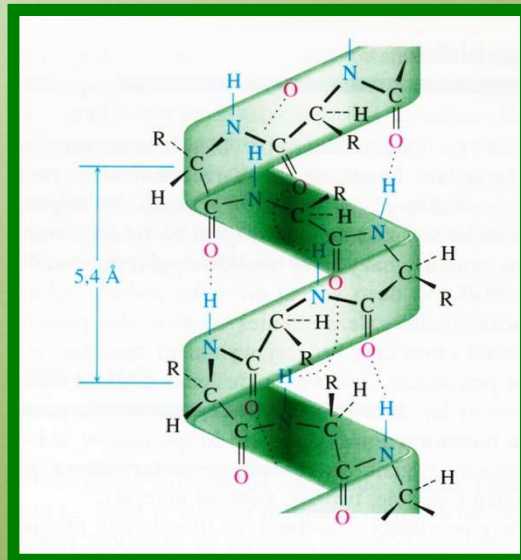


# ATR - FTIR

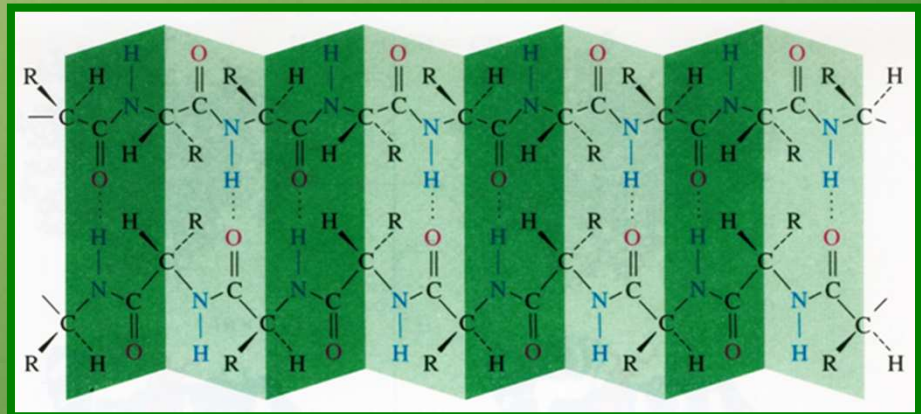


# Protein structure

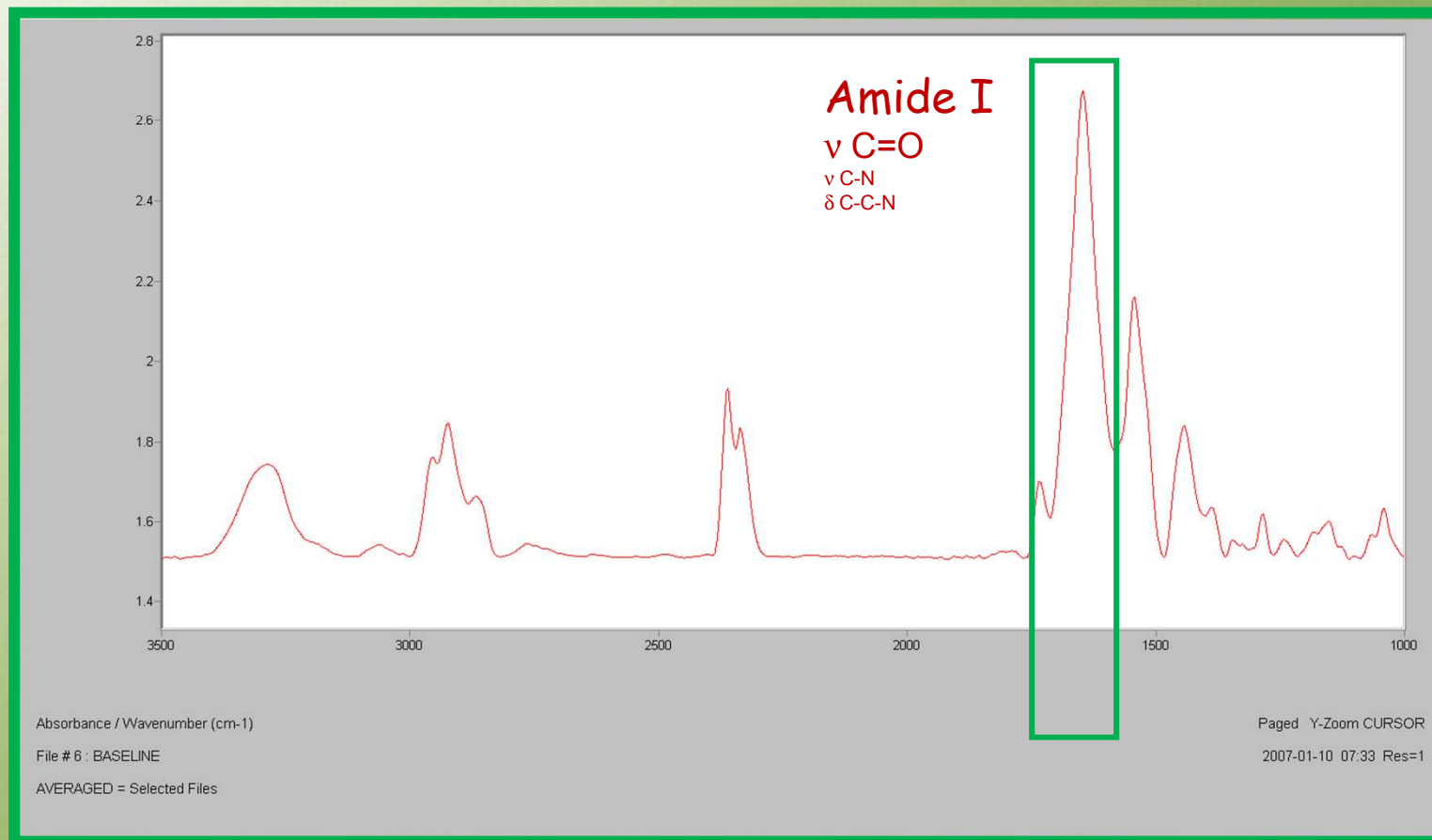
$\alpha$ -helix



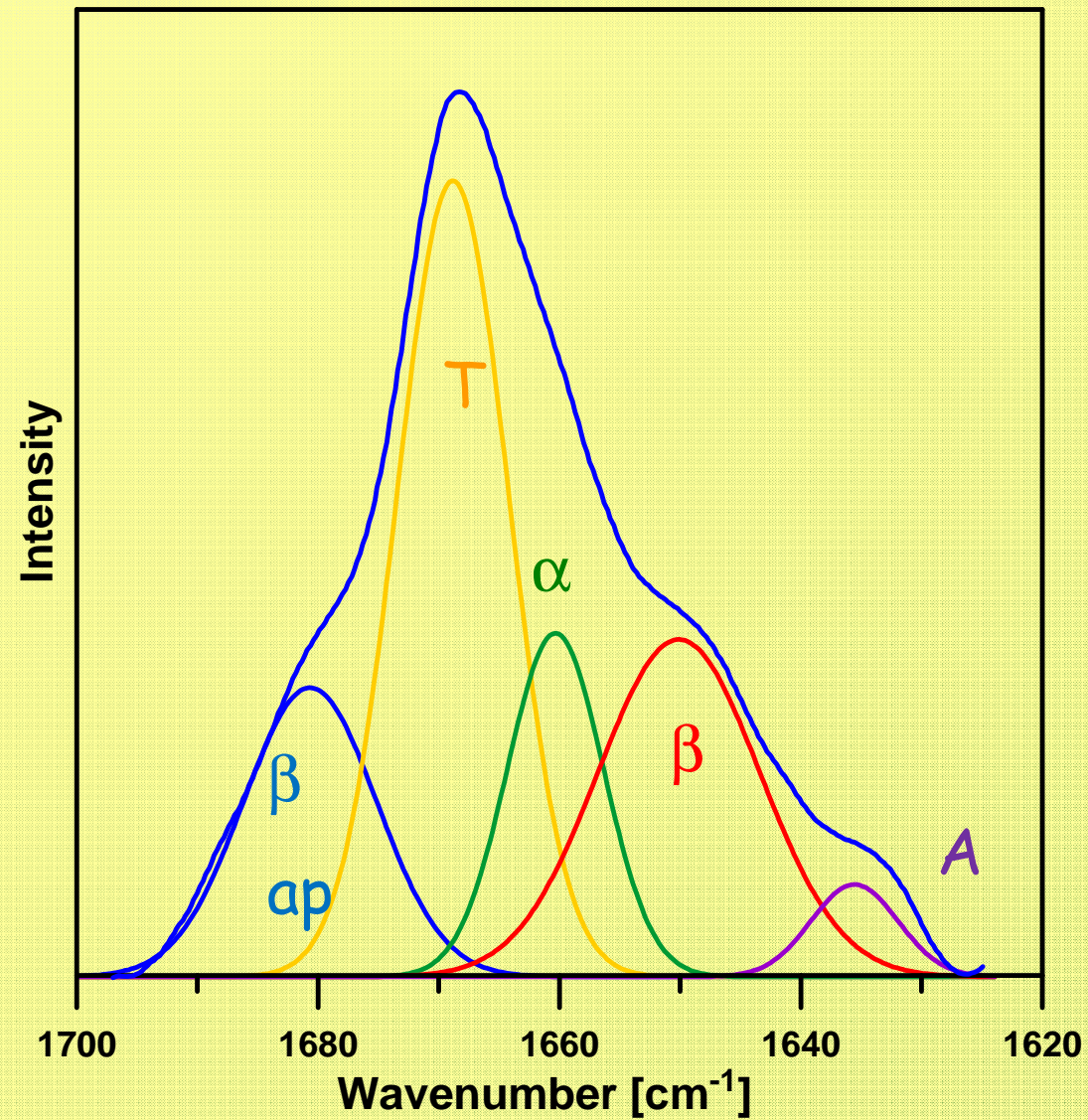
$\beta$ -sheet



# FTIR spectrum of a protein

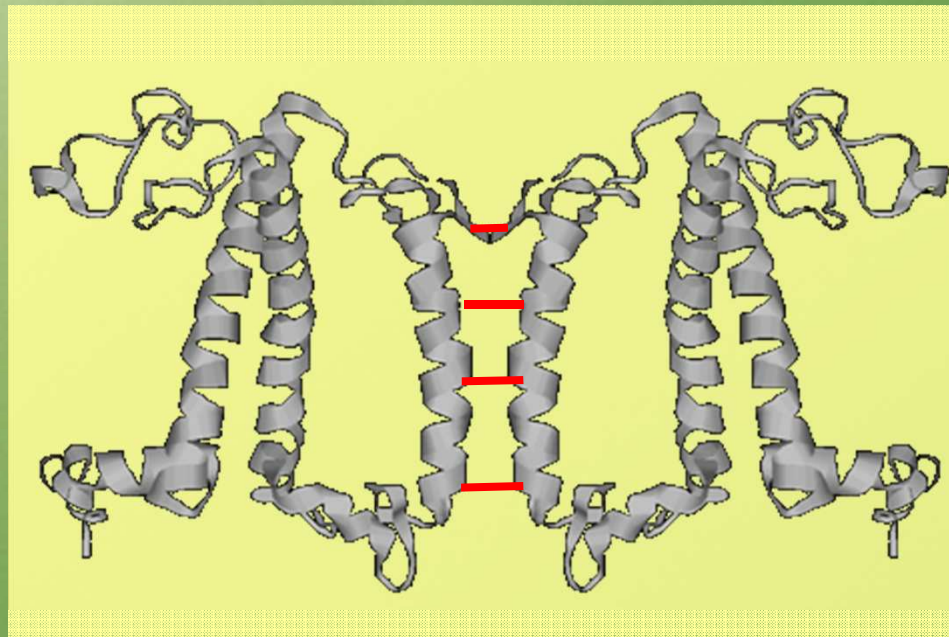
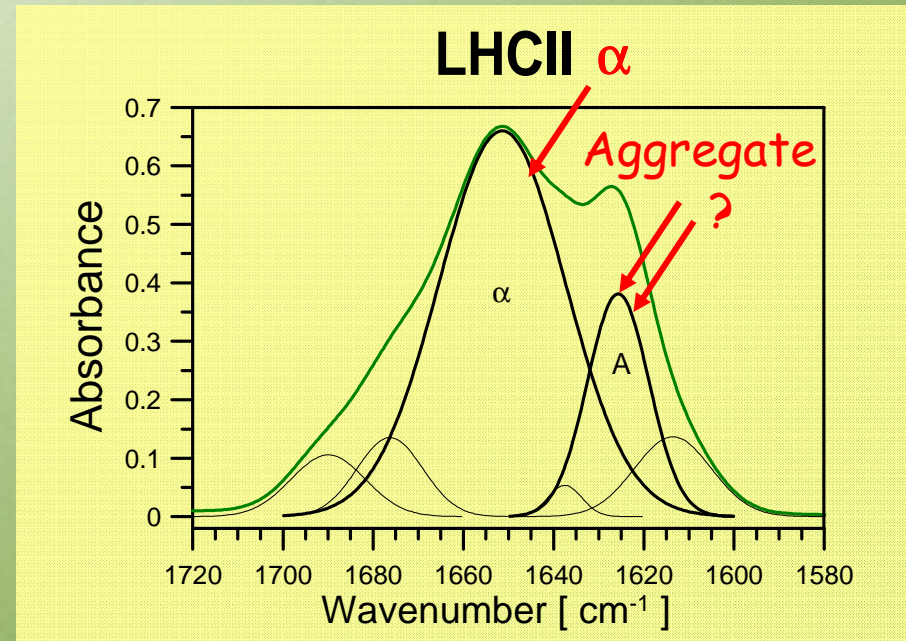


## Analysis of the Amide I band



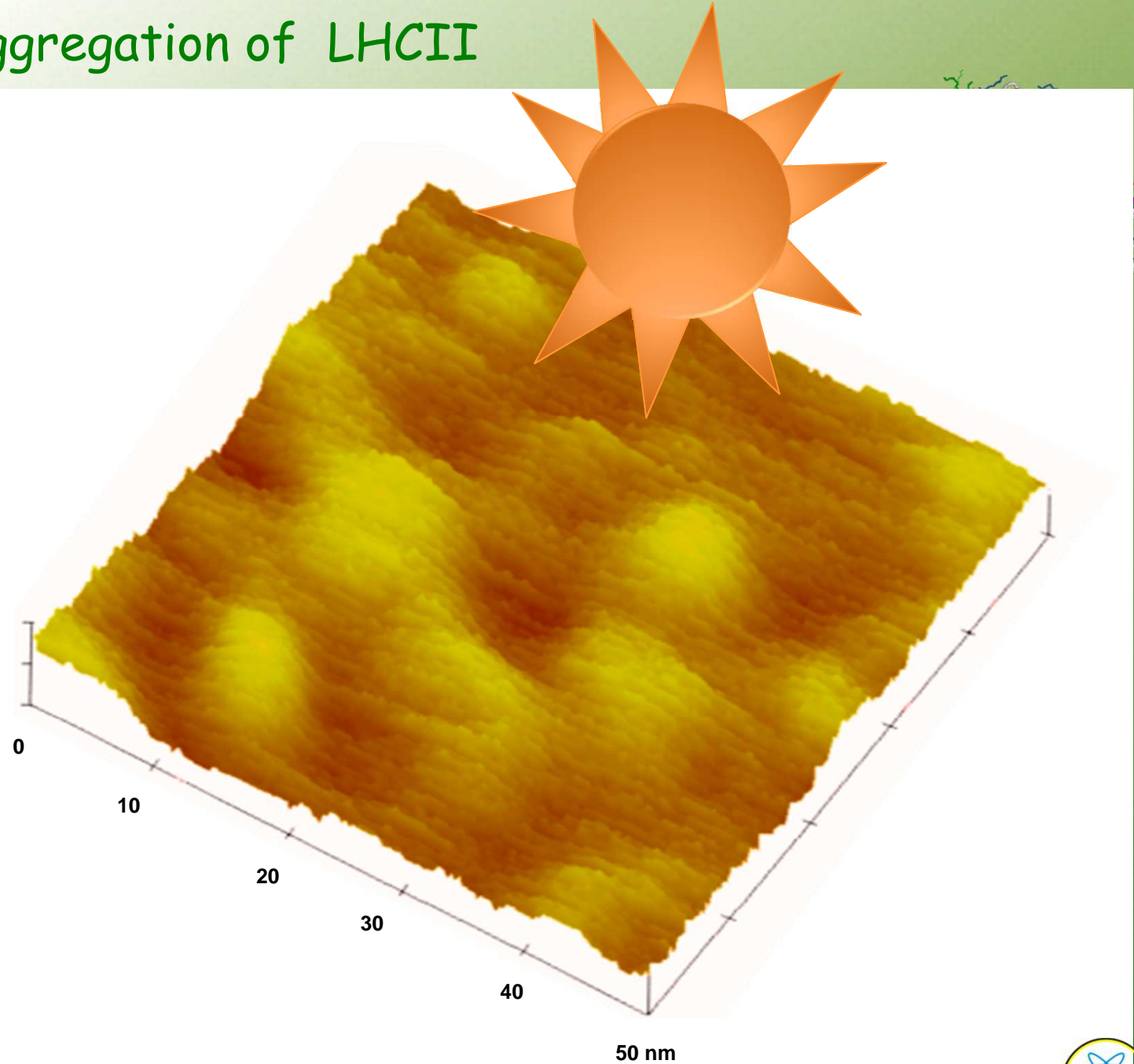


Origin  
of the component A  
in the FTIR spectrum  
of LHCII

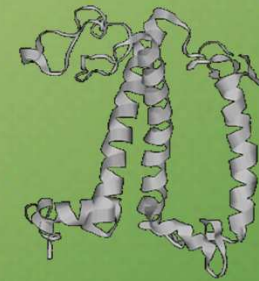
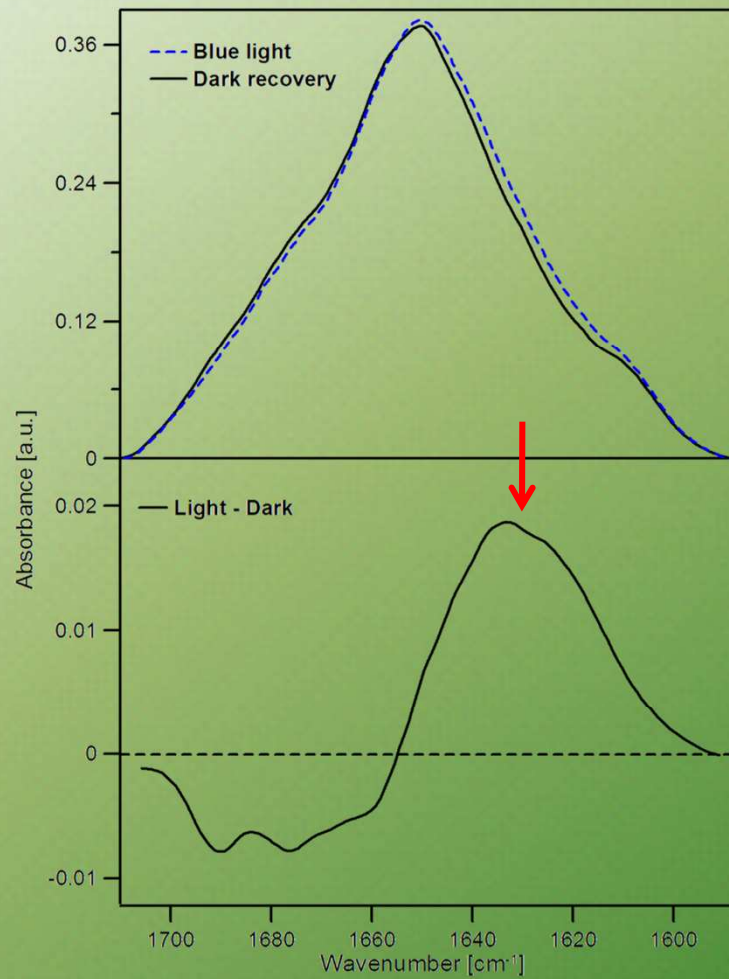




# Aggregation of LHCII



# Blue-light-induced reorganization of LHCII

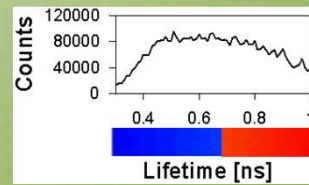
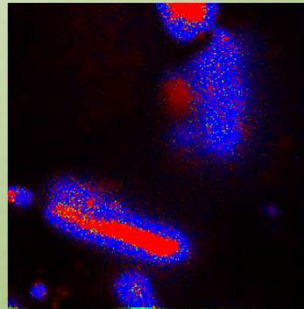


1624 cm<sup>-1</sup>  
 $\gamma=66^\circ$

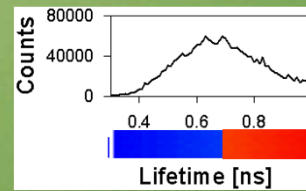
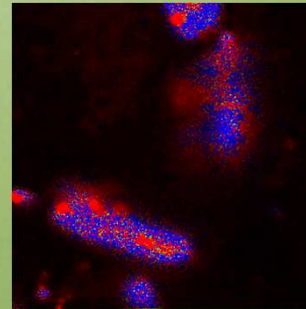
# FLIM

## LHCII aggregated structures

Ex 470 nm



Ex 635 nm



## Conclusions:

1. Illumination of LHCII drives molecular configuration changes of xanthophylls
2. Xanthophyll configuration changes drive reorganization of LHCII
3. Reorganization of LHCII leads to excitation quenching





Thank you for attention!

