The Loroxanthin Cycle

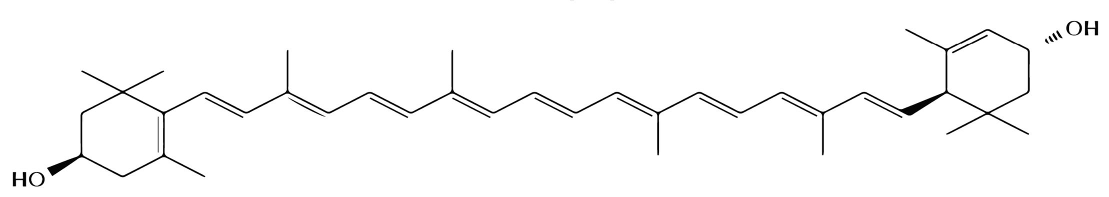
A new xanthophyll cycle in green algae

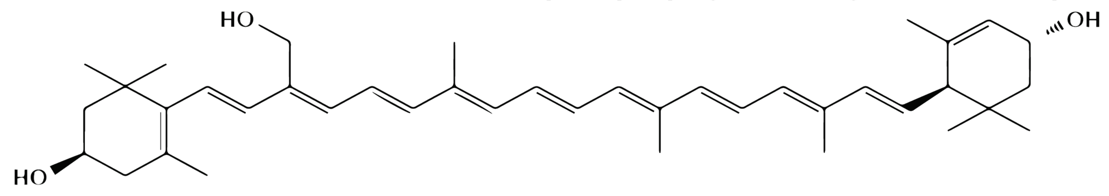
Tomas E van den Berg[1*] & Roberta Croce[1]

[1]VU University Amsterdam, Biophysics of Photosynthesis [*]University of Twente, Integrated Devices and Systems

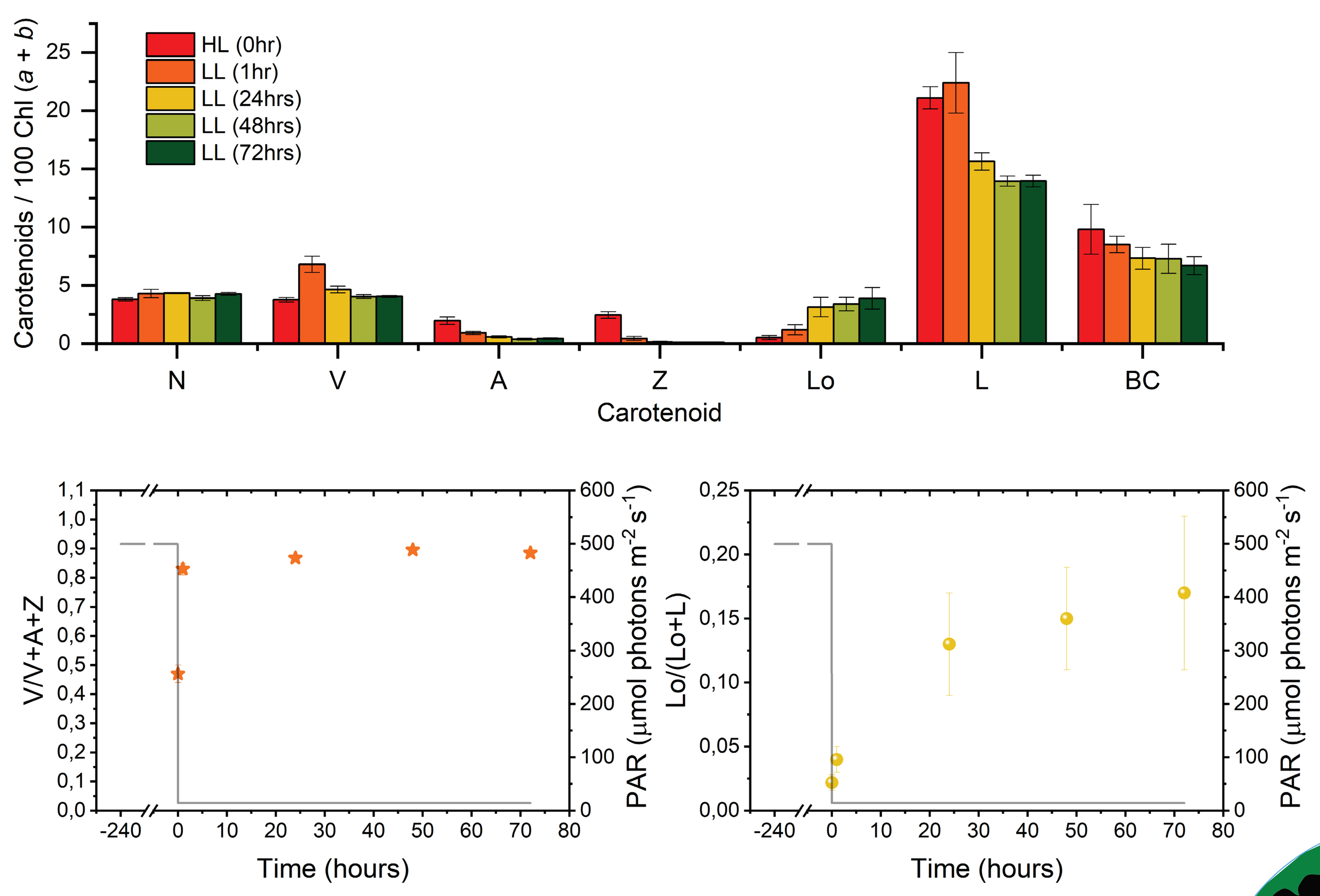
Photoacclimation mechanisms are critical for the success of photosynthetic organisms and the xanthophyll cycles have proven to be major contributors to photoacclimation. Thus far six xanthophyll cycles have been described but more may be present, especially among algae. Here we presented a new xanthophyll cycle present in *Chlamydomonas reinhardtii*: the Loroxanthin cycle, operating with the xanthophylls

Lutein (L) and Loroxanthin (Lo) (hydroxy-Lutein)

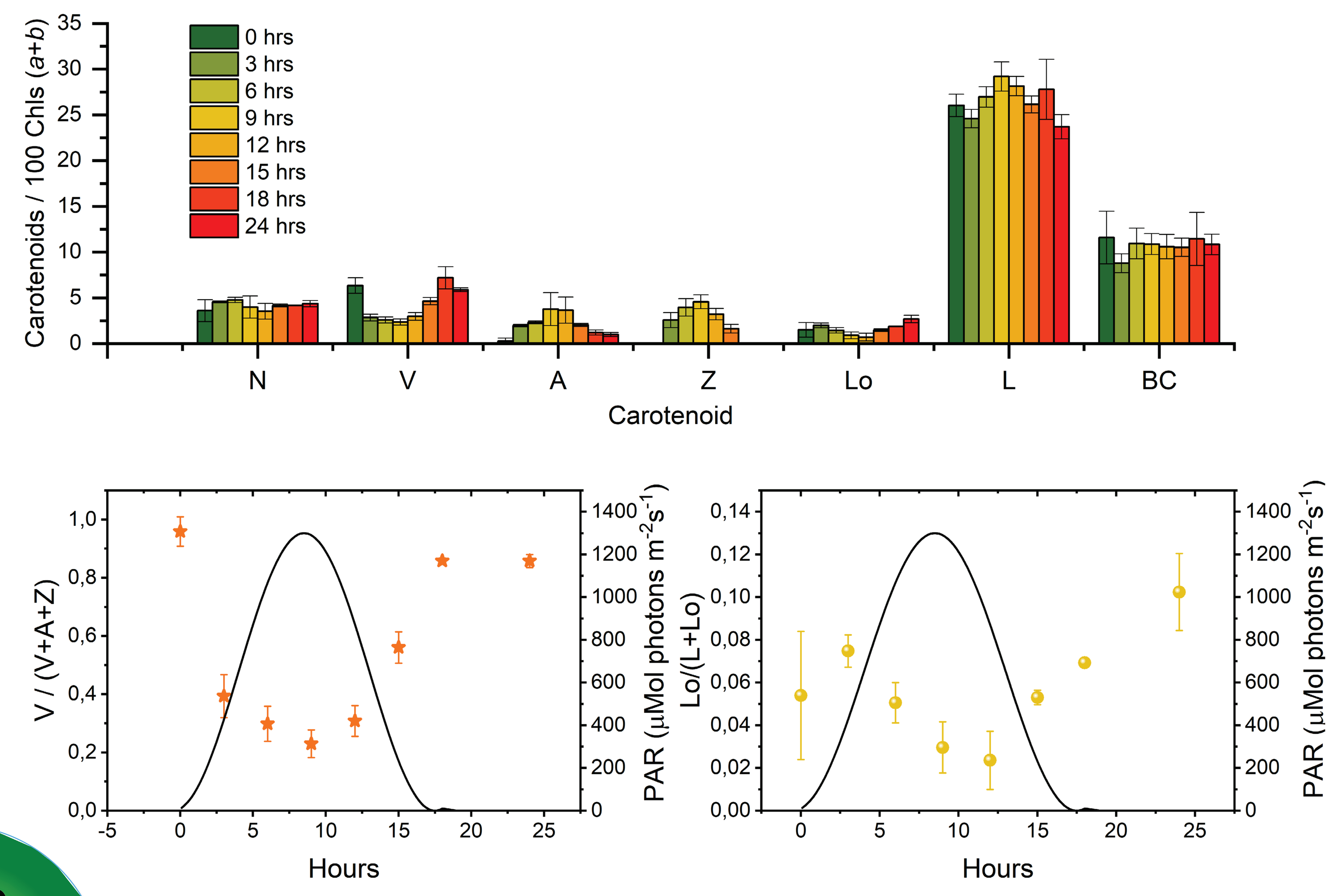


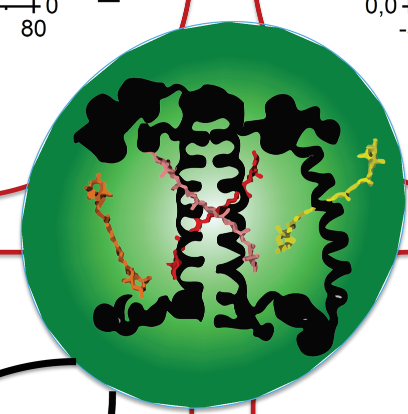


The Loroxanthin cycle is slow compared to the Violaxanthin cycle upon a sustained change in light intensity, demonstrated by cellular pigment ratios



Diurnal changes in cellular pigment ratios by the Loroxanthin cycle are smaller than those after sustained changes in light intensity





The Loroxanthin cycle changes the pigment composition of LHCII

LHCII	Chl a/b	Chl/ Car	N	V	A	Lo	L
LHCII-LL	1.17*	3.74	0.76	0.49*	0	**1.3***	**1.3***
(SE, n=4)	(0.04)	(0.18)	(0.03)	(0.04)		(0.3)	(0.2)
LHCII-HL	1.29*	3.78	0.6	0.25*	0.08	**0.18***	**2.5***
(SE, n=4)	(0.05)	(0.13)	(0.1)	(0.03)	(0.13)	(0.06)	(0.1)

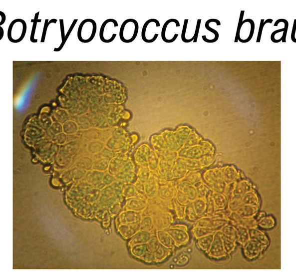
Loroxanthin bound to LHCII instead of Lutein affect some of its properties: 5% higher excitation energy transfer from Carotenoids to Chlorophyll

LHCII	AVERAGE FLUORESCENCE LIFETIME (NS)	CAROTENOID TO CHL EET EFFICIENCY %	THERMOSTABILITY TRANSITION TEMPERATURE (°C)	PHOTOSTABILITY PHOTOBLEACHING RATE
-LL (LO)	3.0 ± 0.2	90 ± 1 *	81 ± 0.3	-0.50 ± 0.03 *
-HL (L)	3.0 ± 0.3	86 ± 2 *	74 ± 0.3	-0.59 ± 0.03 *

The Loroxanthin cycle is probably active in the *Chlorophyte*, *Euglenophyte* and *Chlorarachniophyte*

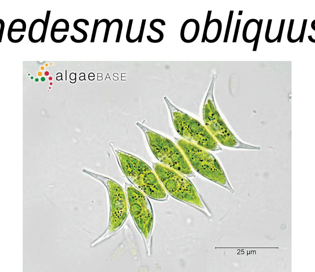
- Presence of Loroxanthin could be a likely indicator of the Loroxanthin cycle.
- Light-intensity induced changes of lutein and loroxanthin content were observed in:

Botryococcus braunii



Tetraselmis suecica

Scenedesmus obliquus



The Loroxanthin cycle has similar properties as the Lutein – Lutein-Epoxide cycle in plants

- Slower kinetics than the Violaxanthin cycle
- Changes the carotenoid composition of LHCII
- Changes the carotenoid to Chlorophyll Excitation energy transfer efficiency

Differences are

- Hydroxylation instead of Epoxidation of Lutein
- Loroxanthin content in *Chlamydomonas* is higher than Lutein-epoxide content in plants

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