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## Supramolecular structures of thylakoid membrane protein complexes

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# **Supramolecular structures of thylakoid membrane protein complexes**

Supercomplex organization under different environmental conditions

# Supramolecular structures of thylakoid membrane protein complexes

## Supercomplex organization under different environmental conditions

Rameez Arshad  
PhD Thesis  
University of Groningen

This Ph.D. study was performed jointly at Groningen Biomolecular Science and Biotechnology Institute, Faculty of Science and Engineering, University of Groningen and Department of Biophysics, Faculty of Science, Palacký University Olomouc. This work was financed in part by Marie Skłodowska-Curie innovative training network grant agreement number 675006.



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# **Supramolecular structures of thylakoid membrane protein complexes**

Supercomplex organization under different environmental conditions

## **PhD Thesis**

to obtain the degree of PhD of the  
 University of Groningen  
 on the authority of the  
 Rector Magnificus Prof. C. Wijmenga  
 and in accordance with  
 the decision by the College of Deans

and

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Double PhD degree

This thesis will be defended in public on  
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## Abbreviations

CCD	charge coupled device
Cc	chromatic aberration
Cs	spherical aberration
Cryo-EM	cryo-electron microscopy
Cryo-SEM	cryo-scanning electron microscopy
cryo-ET	cryo-electron tomography
CSTET	cryo-scanning transmission electron microscopy tomography
CTF	contrast transfer function
DDD	direct detection device
DQE	detector quantum efficiency
FCP	fucoxanthin chl <i>a/c</i> -binding proteins
Fd	ferredoxin
FEG	field emission gun
FNR	ferredoxin NADP <sup>+</sup> reductase
LHC	light-harvesting complex
MSA	multivariate statistical analysis
NPQ	non-photochemical quenching
OEC	oxygen evolving complex
PBS	phycobilisomes
Pc	plastocyanin
PSI	photosystem I
PSII	photosystem II
SGB	Suc-gradient band
SPA	single particle analysis
RC	reactions center
ROS	reactive oxygen species
SNR	signal to noise ratio
TEM	transmission electron microscope
VPP	Volta phase plate