

Bioinformatic Study on the *Arabidopsis*

UV-B Photoreceptor UVR8

G02B

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Qing Liang Diqiu Ren

January 10, 2014

Outline

1. Analysing the basic properties and structure of UVR8

- Background and questions
- Analysis procedure
- Experimental evidences
- Conclusions

2. Analysing how UVR8 positively regulates HY5

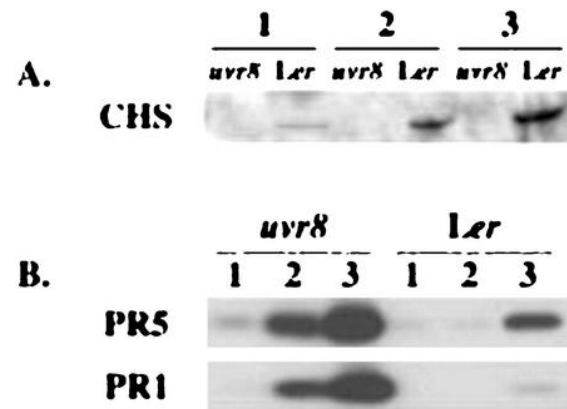
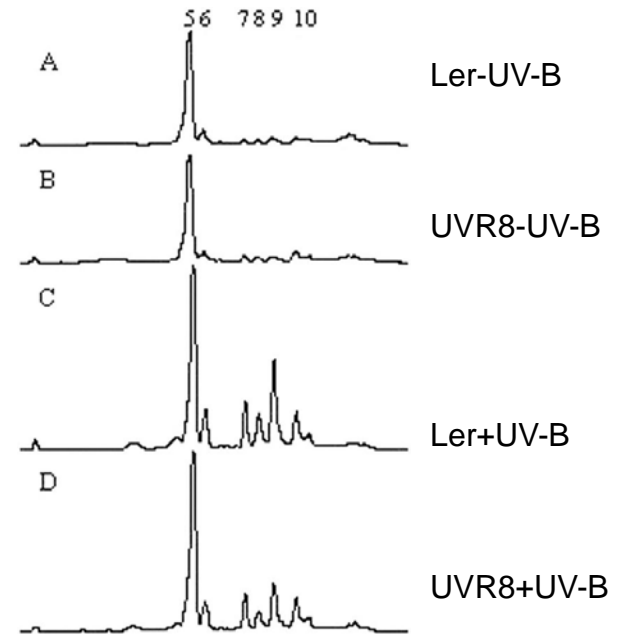
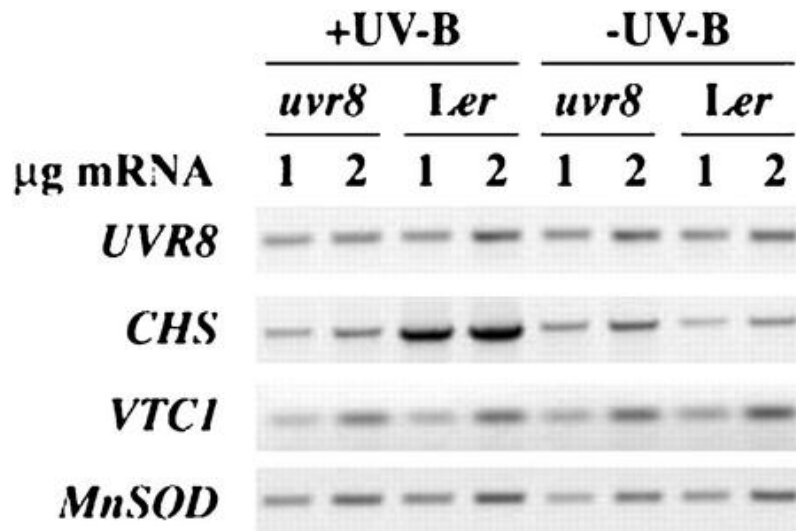
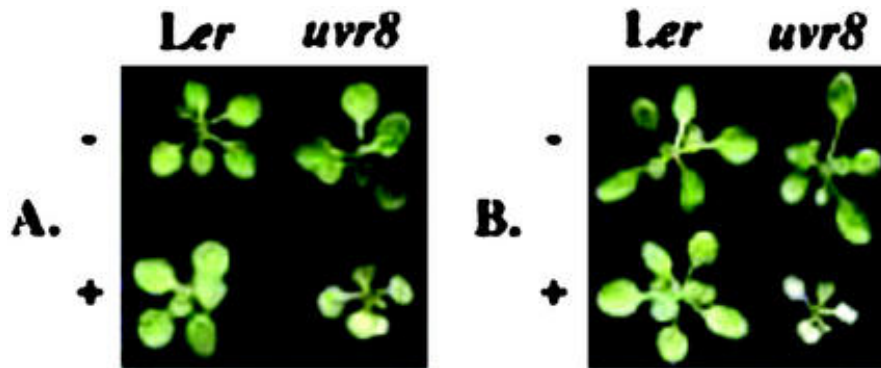
by COP1

- Background and question
- Analysis procedure
- Hypothesis

Part I : Analysing the basic properties and structure of UVR8

Background

1. Discovery of UVR8



Kliebenstein *et al.*, 2002

Background

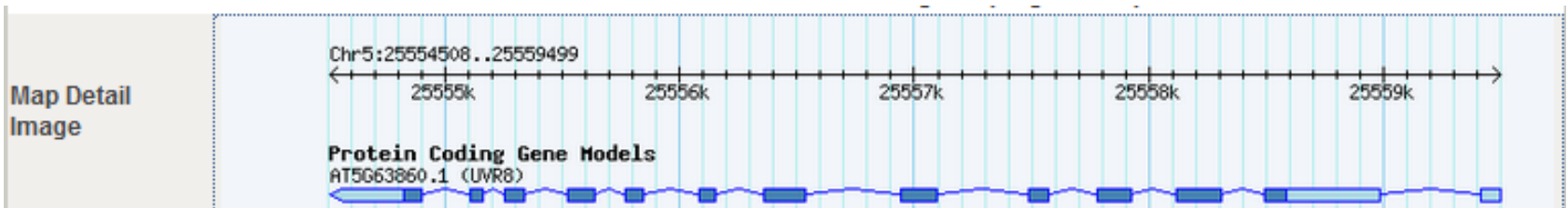
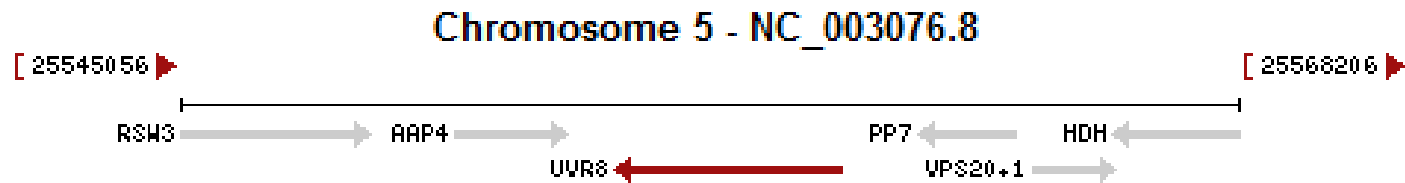
2. *UVR8* and UVR8

Gene ID: 836506

TAIR:AT5G63860

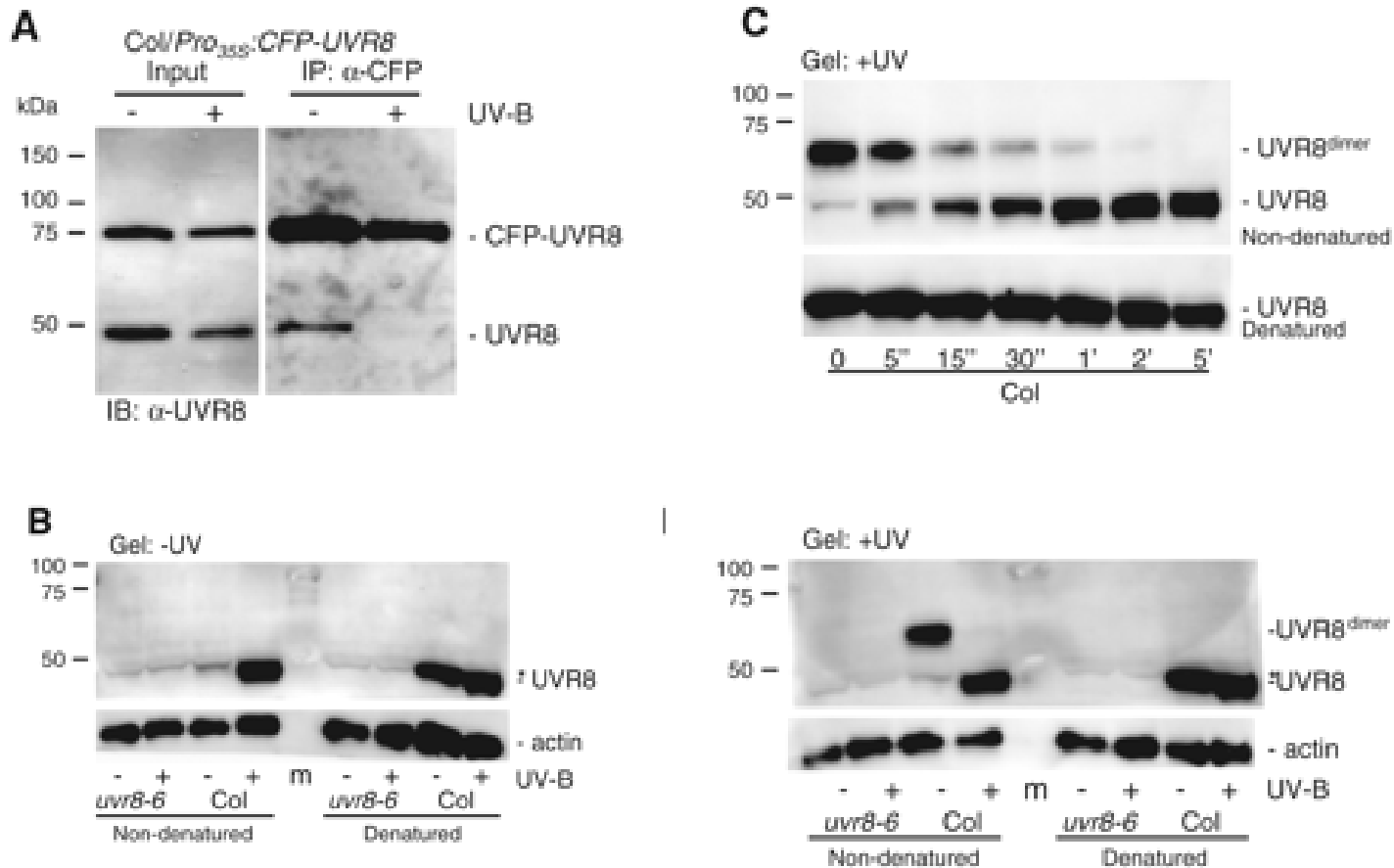
UniProt: Q9FN03

Sequence length: 440AA



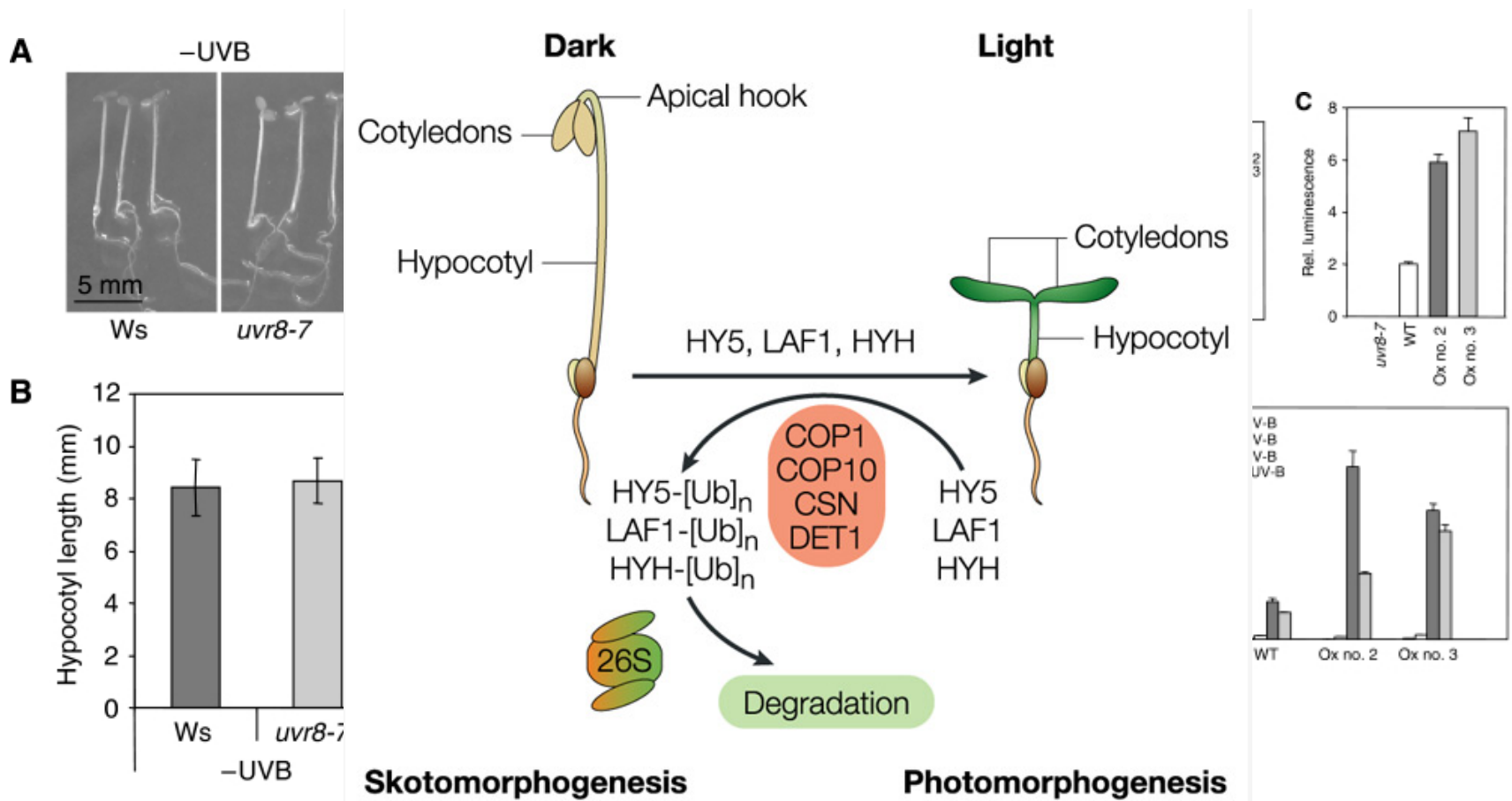
Background

3. UVR8 responses UV-B



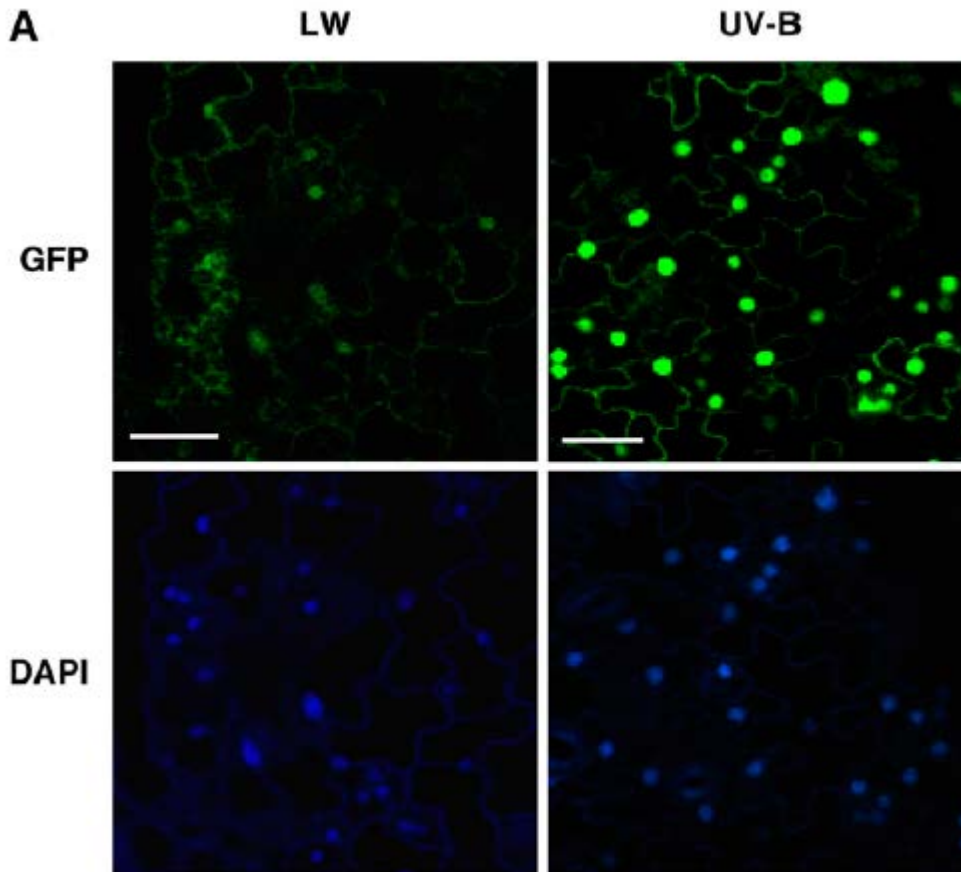
Background

4. UVR8 signal transduction

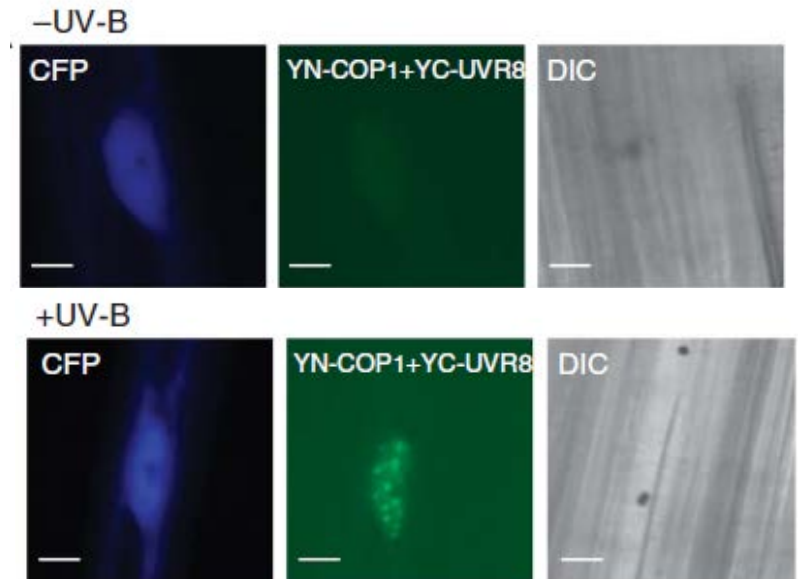


Background

5. UVR8 subcellular localization



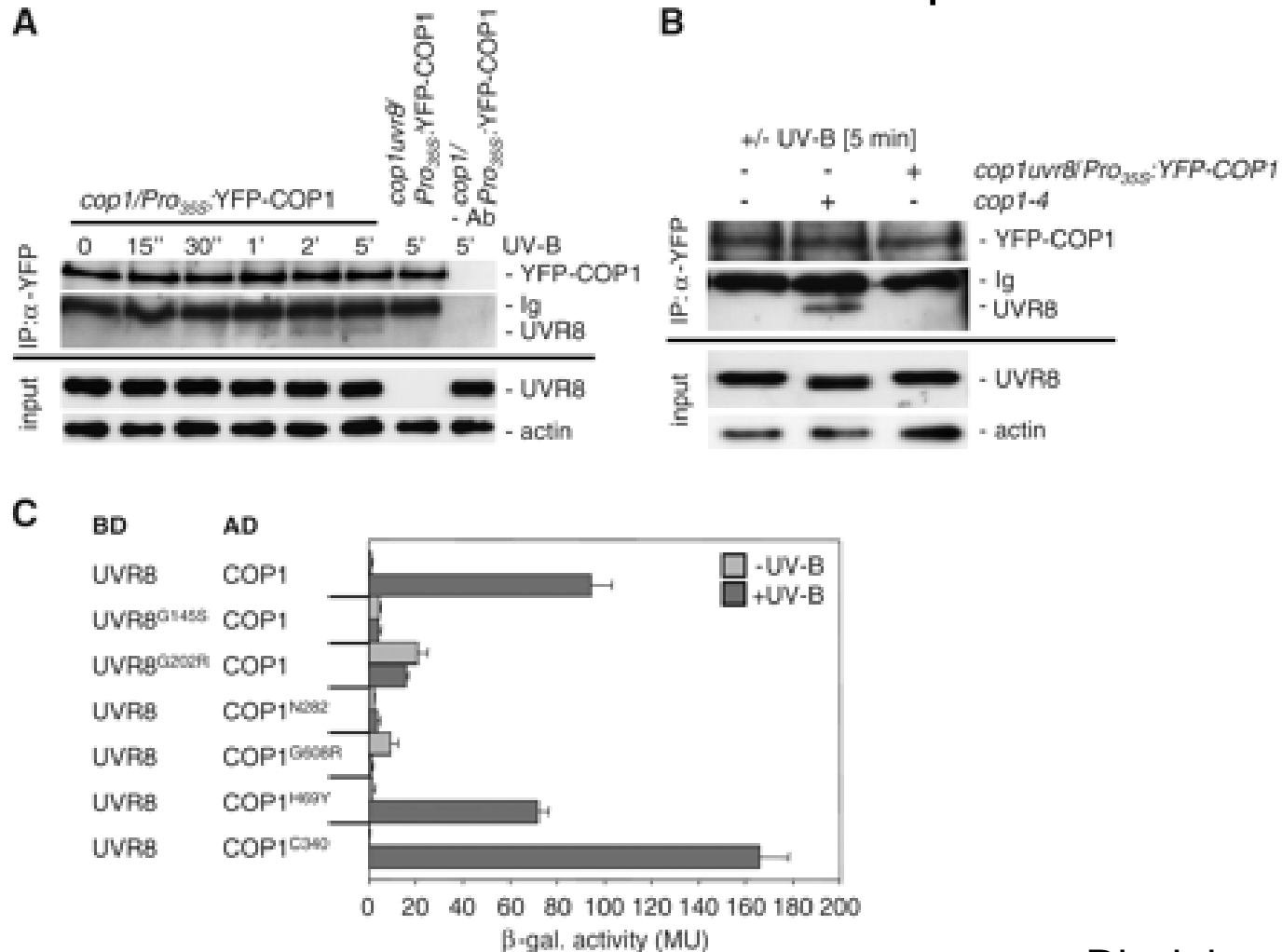
Kaiserli *et al.*, 2007



Favory *et al.*, 2009

Background

6. UVR8 interacts with COP1 in a UV-B-dependent manner



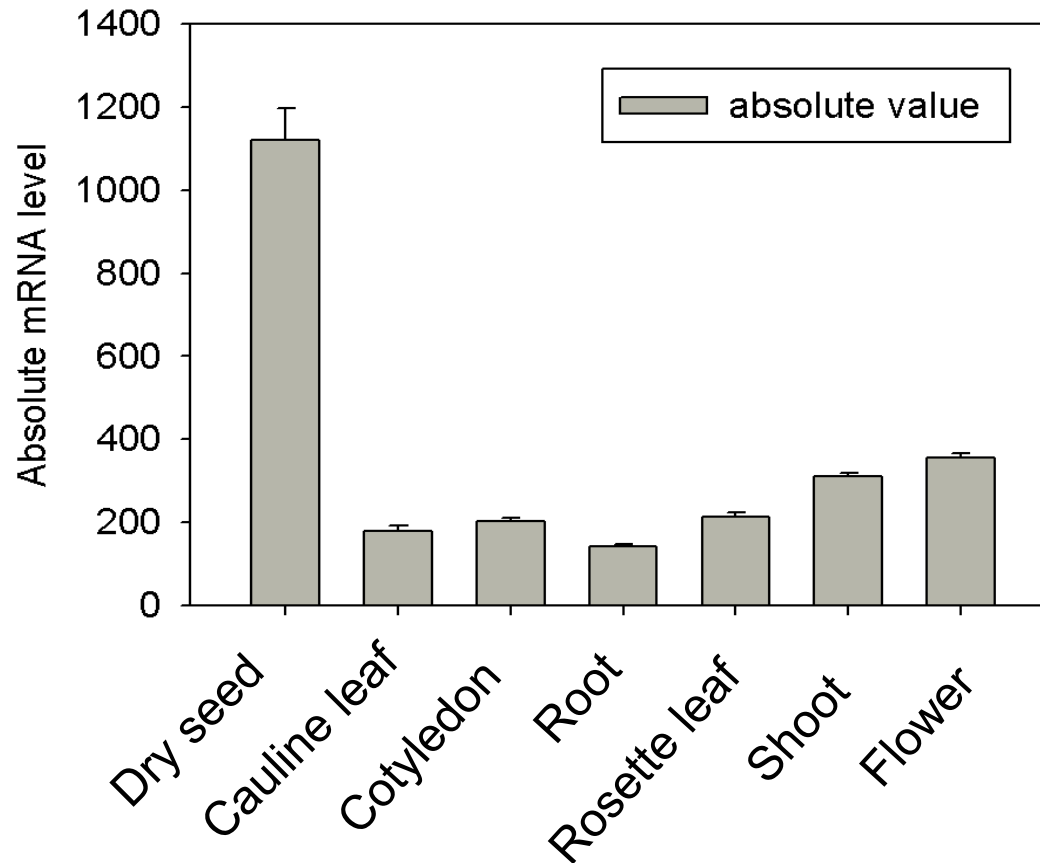
Questions

1. How does the UVR8 maintain homodimer?
2. What is the UVR8's chromophores?

Analysis procedure

e-FP Browser

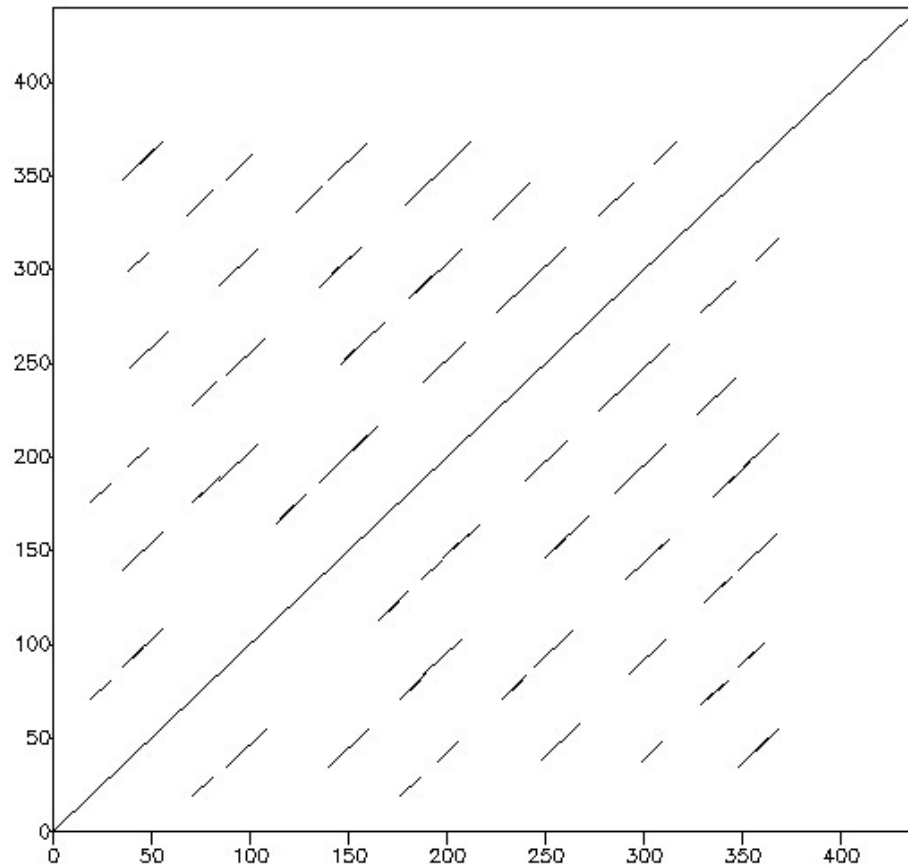
UVR8 tissue-specific expression



Analysis procedure

Dotmatcher

Repeated sequence of UVR8



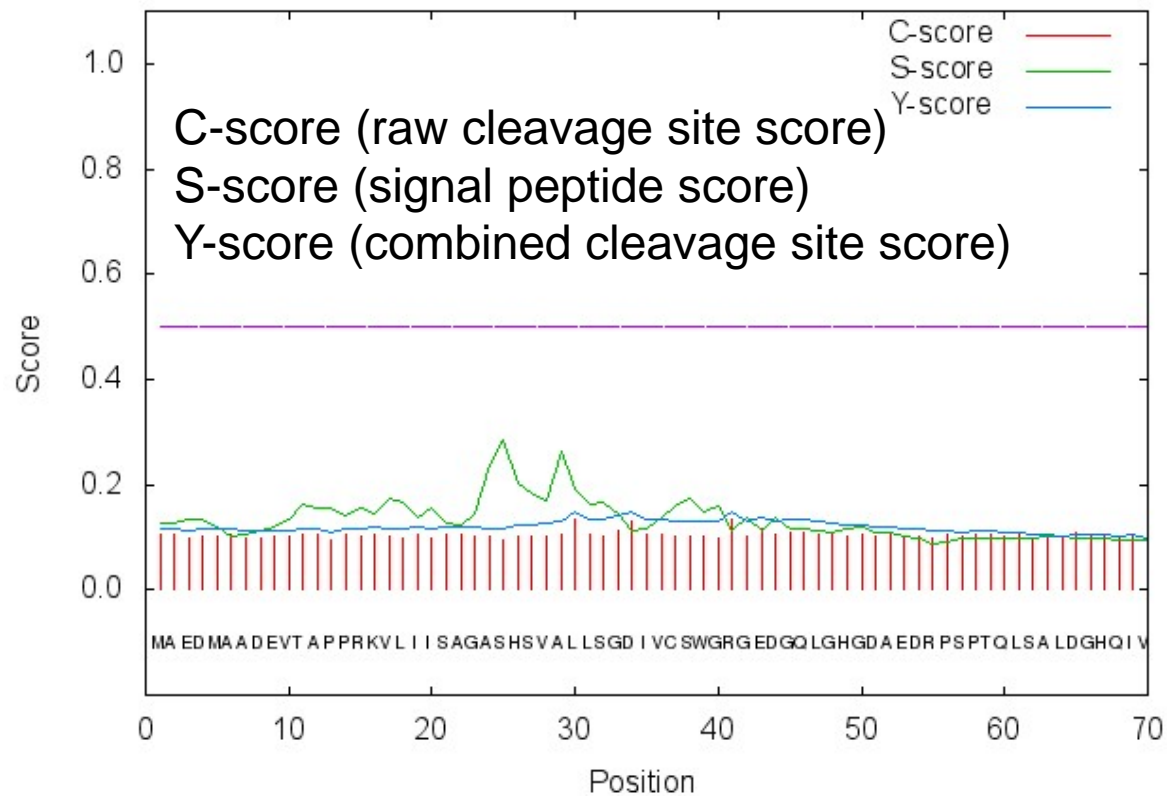
Wordsize: 10

Threshold: 30

Analysis procedure

SignalP

Signal peptide prediction



Analysis procedure

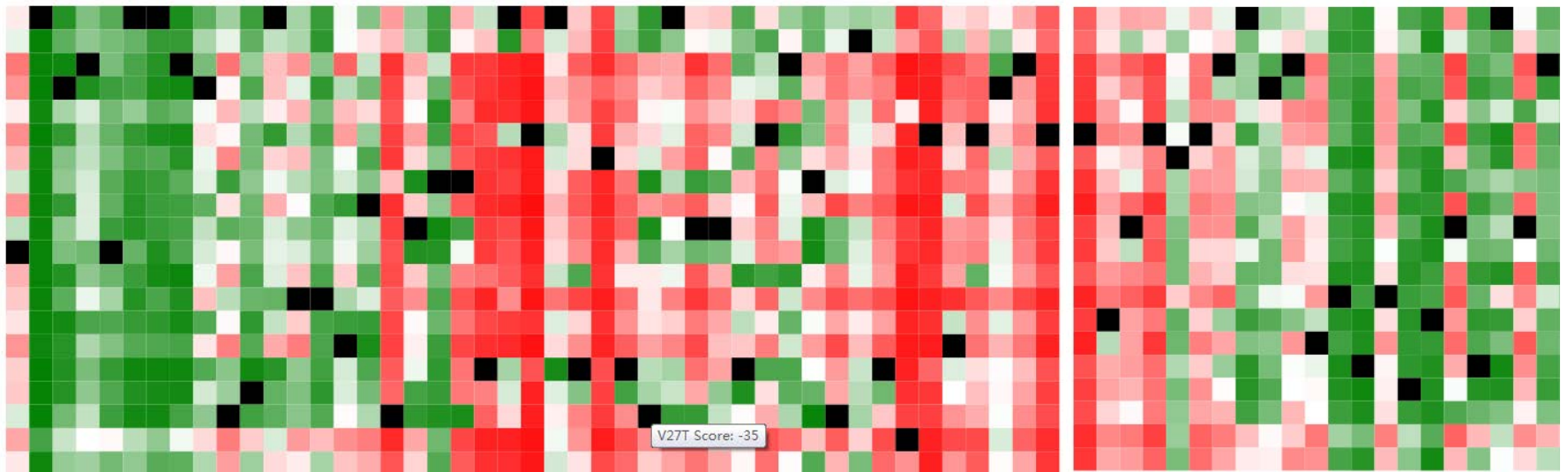
PredictNLS

Predict nuclear localization signal(NLS)

Prediction of Nuclear Localization Signals (NLS)

This protein does **not contain** a nuclear localization signal

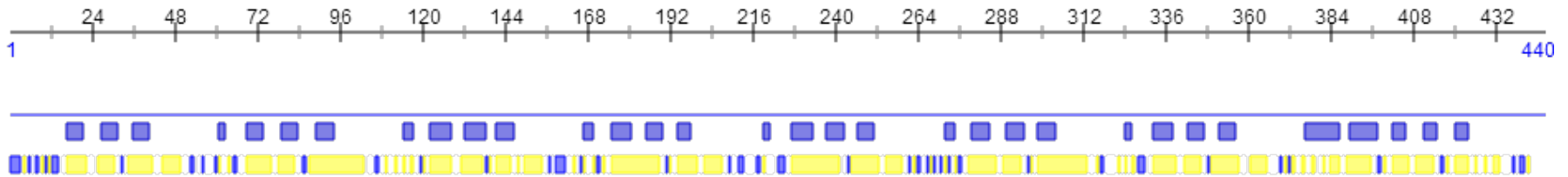
Effect of Point Mutations Prediction



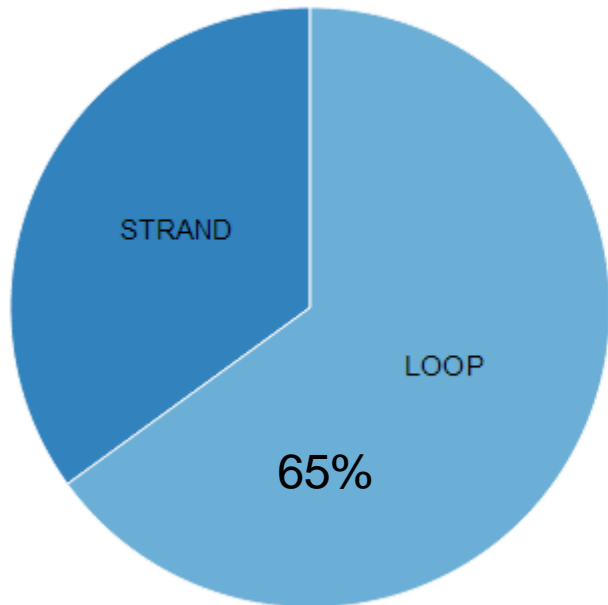
Analysis procedure

PredictNLS

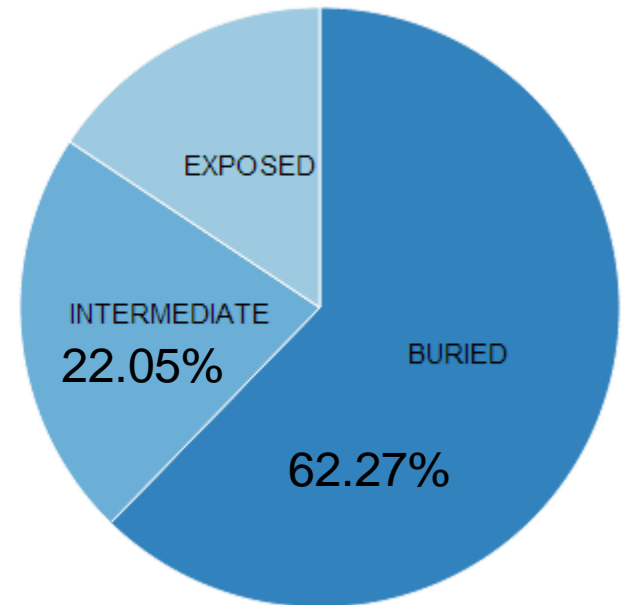
Secondary Structure and Solvent Accessibility Prediction



Secondary Structure Composition



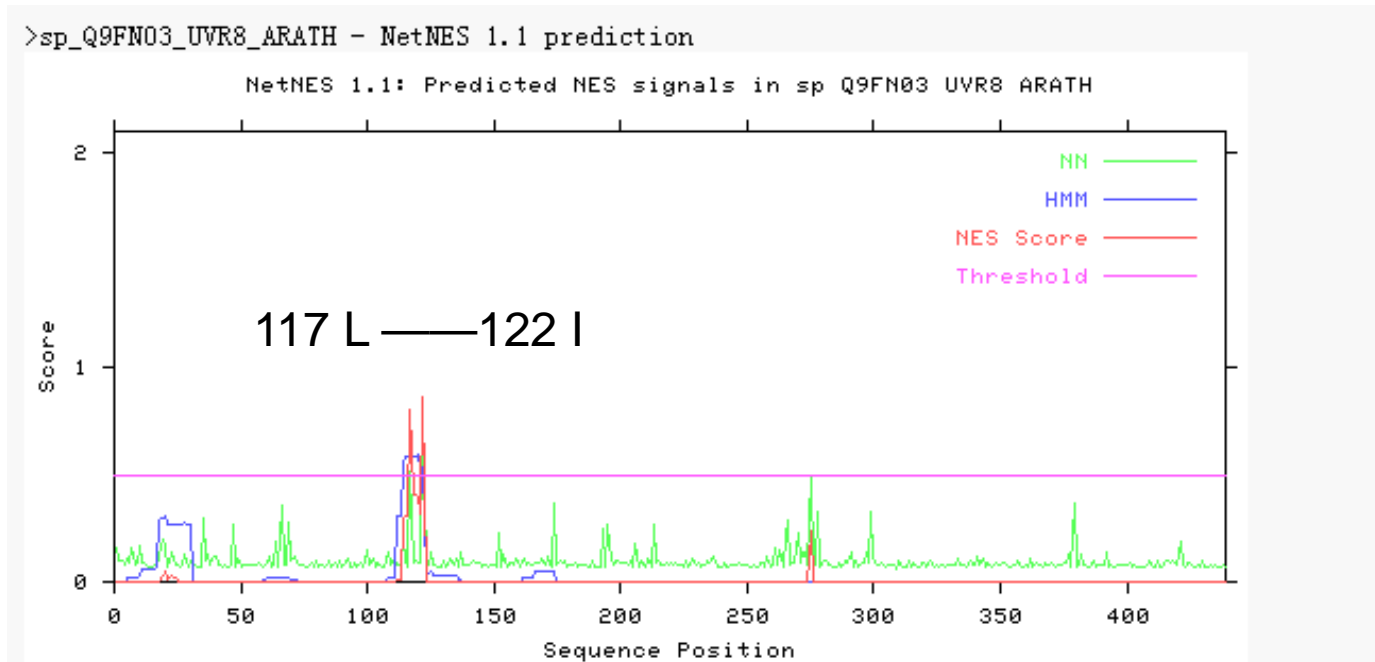
Solvent Accessibility



Analysis procedure

NETNES

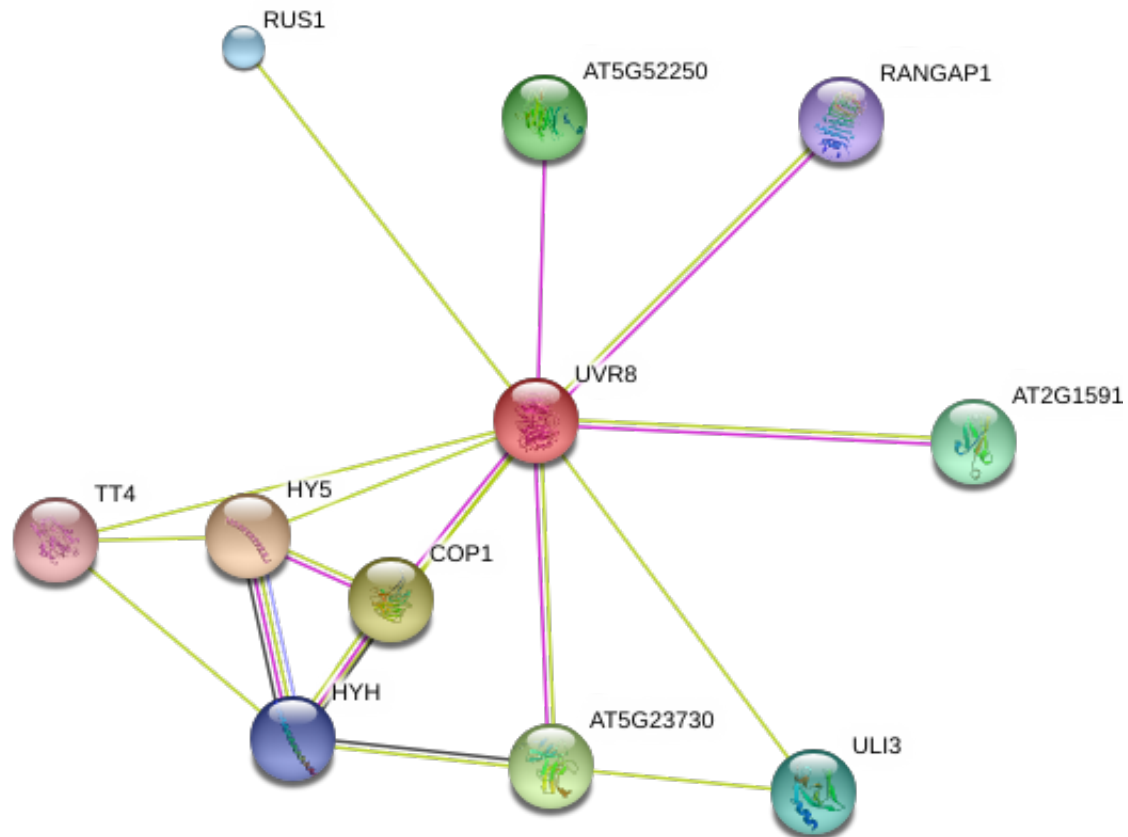
Predict nuclear export signal(NES)



Analysis procedure

STRING 9.1

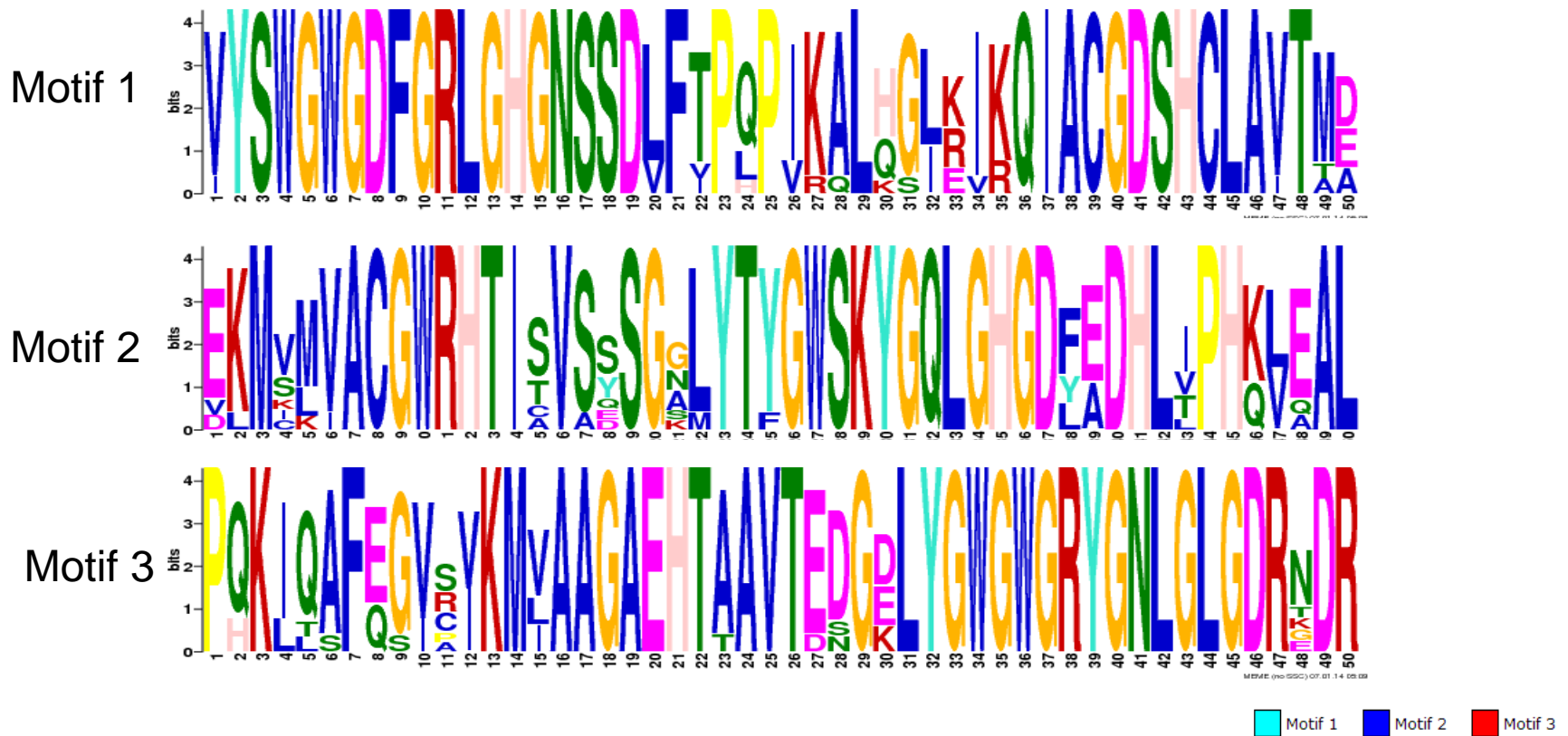
Interaction proteins



Analysis procedure

MEME 4.9.1

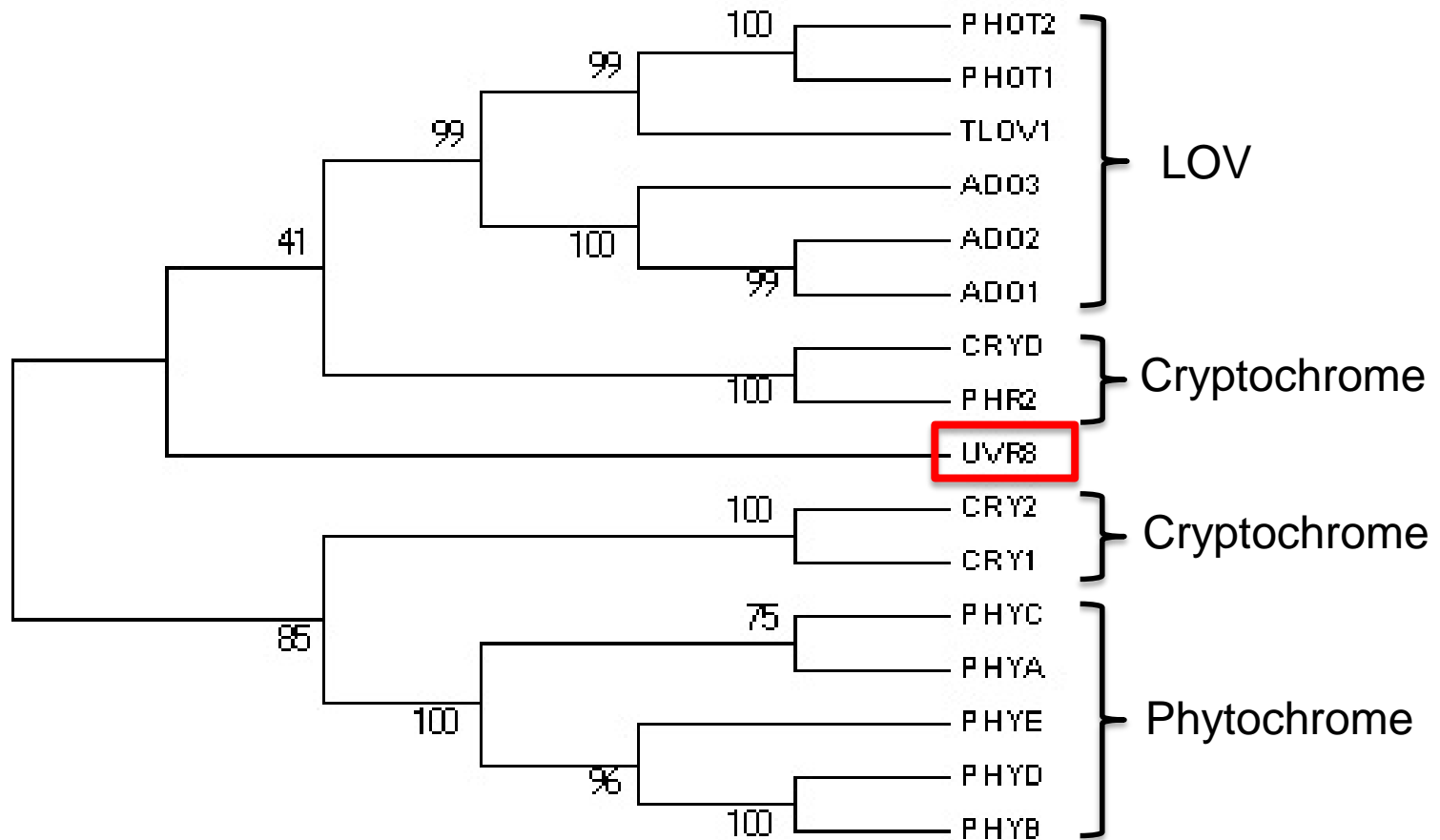
Motif finding



Analysis procedure

Neighbor-Joining Phylogenetic Tree (MEGA 5.2)

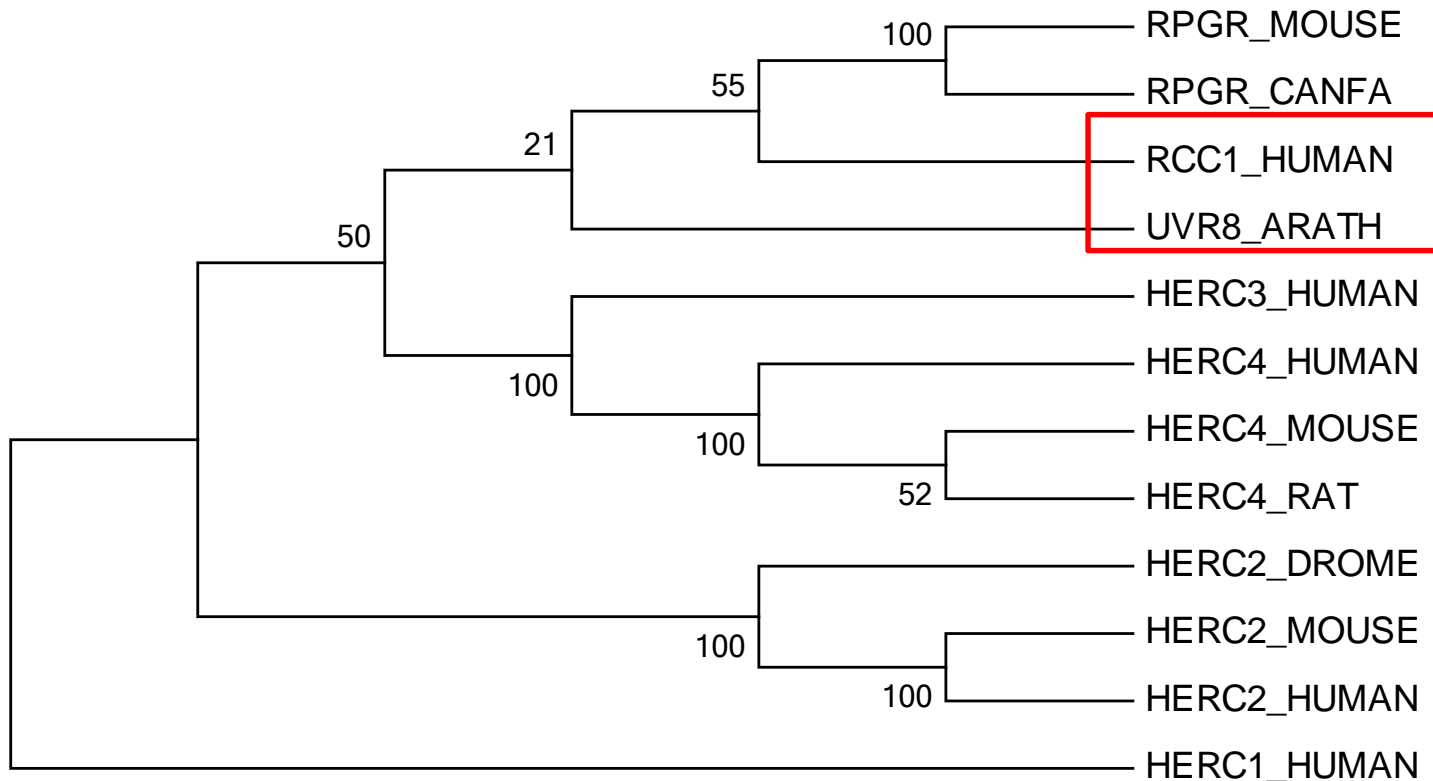
Photoreceptors in *Arabidopsis thaliana*



Analysis procedure

Neighbor-Joining Phylogenetic Tree (MEGA 5.2)

Homologous protein of UVR8



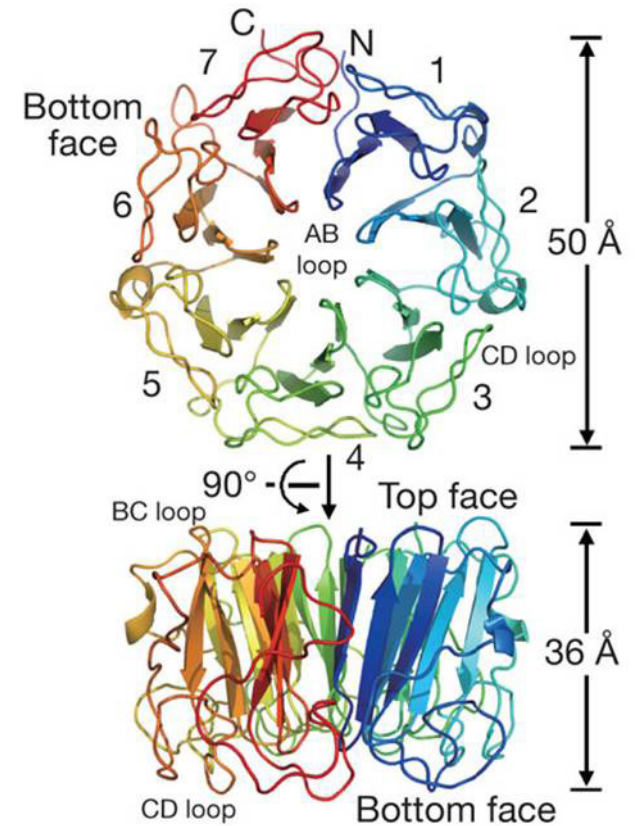
Analysis procedure

SWISS-MODEL

Homology model of *Arabidopsis thaliana* UVR8



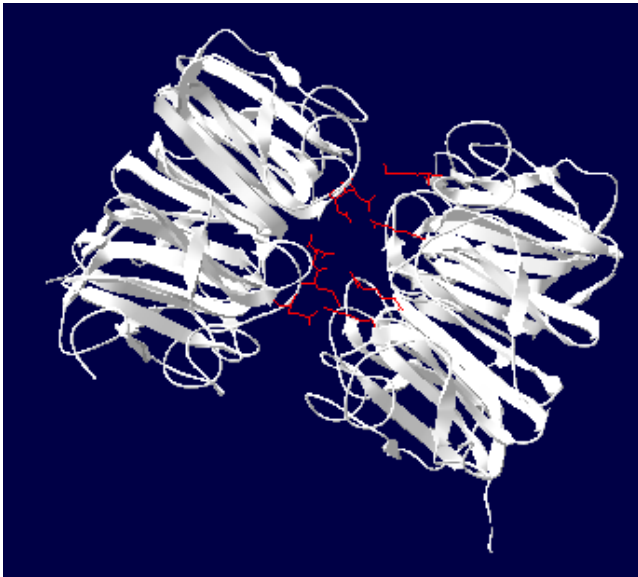
VS



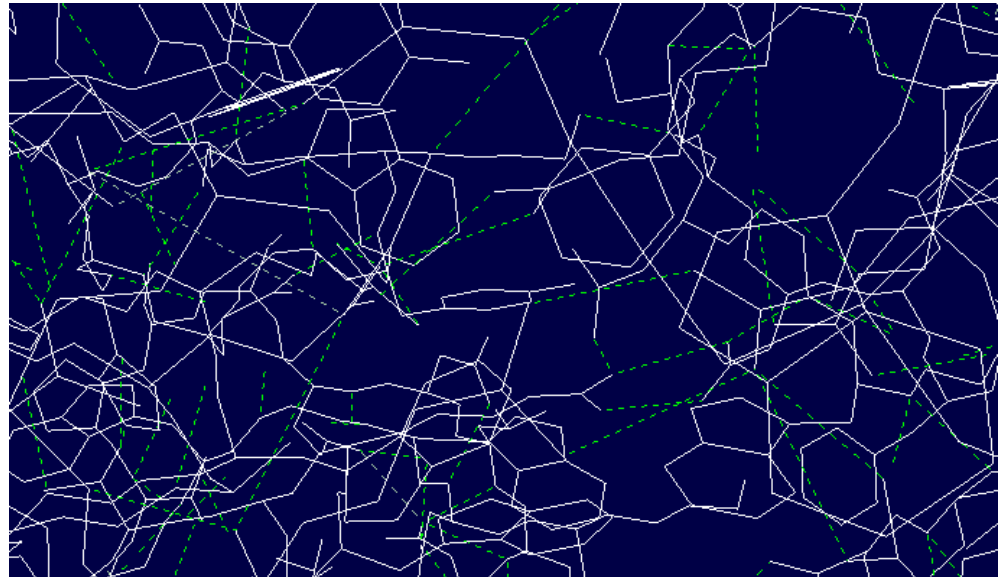
Analysis procedure

Swiss-PdbViewer 4.1.0

Structural basis of UVR8 homodimer formation



Charged attraction

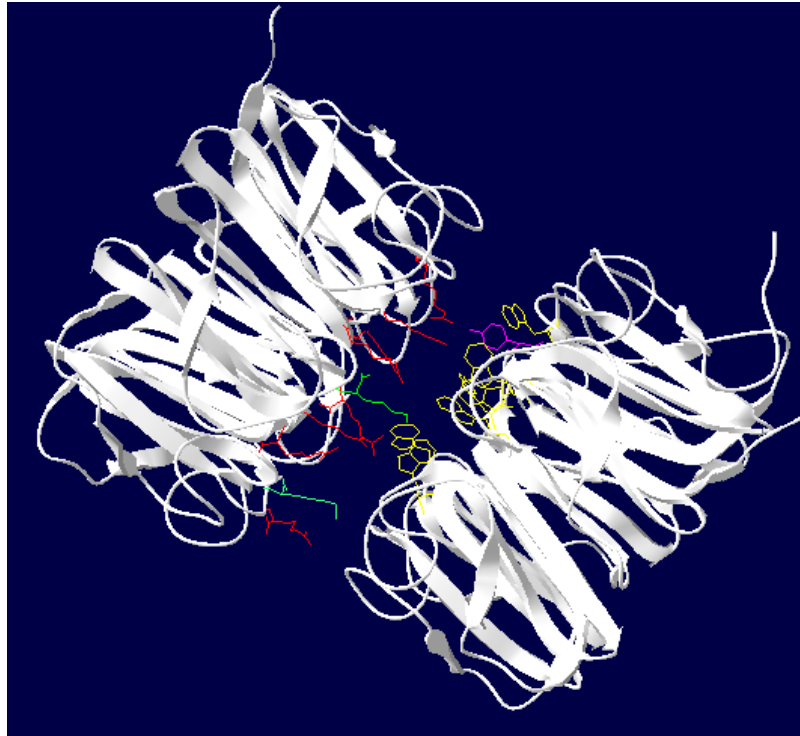


Hydrogen bond

Analysis procedure

Swiss-PdbViewer 4.1.0

Structural basis of UVR8 homodimer formation

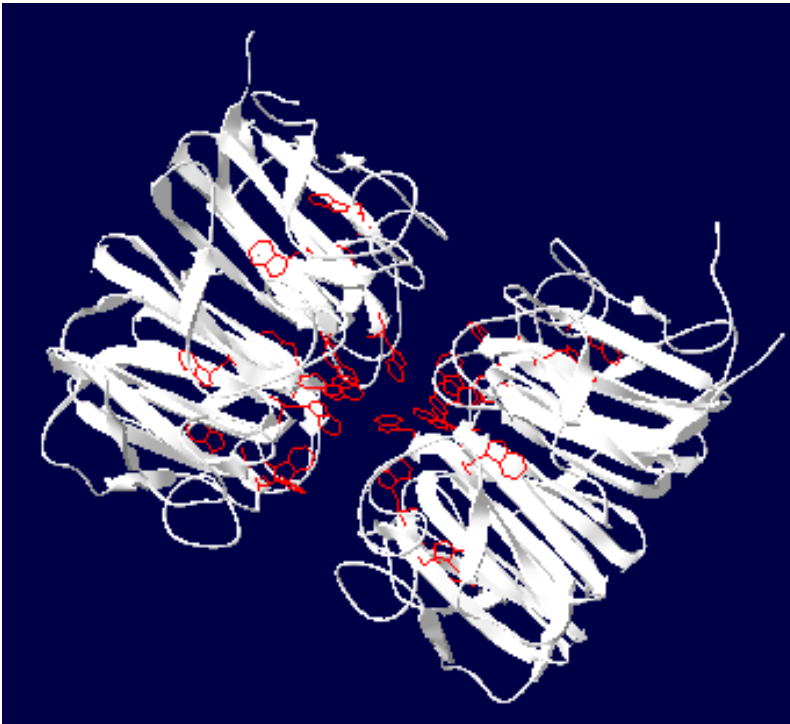


Cation- π interactions

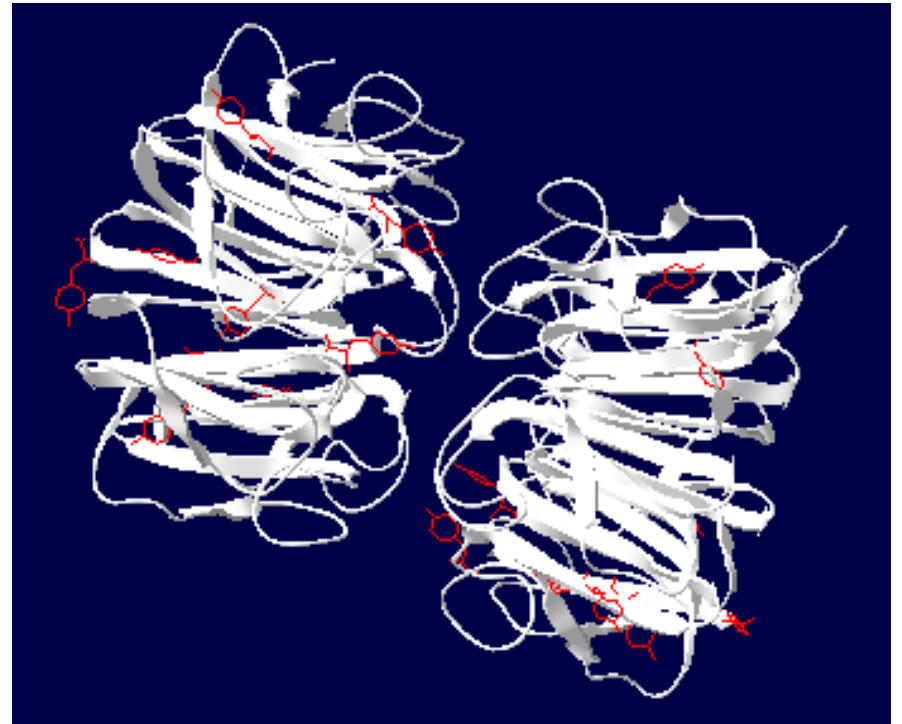
Analysis procedure

Swiss-PdbViewer 4.1.0

Identification of which amino acids as the UV-B chromophore

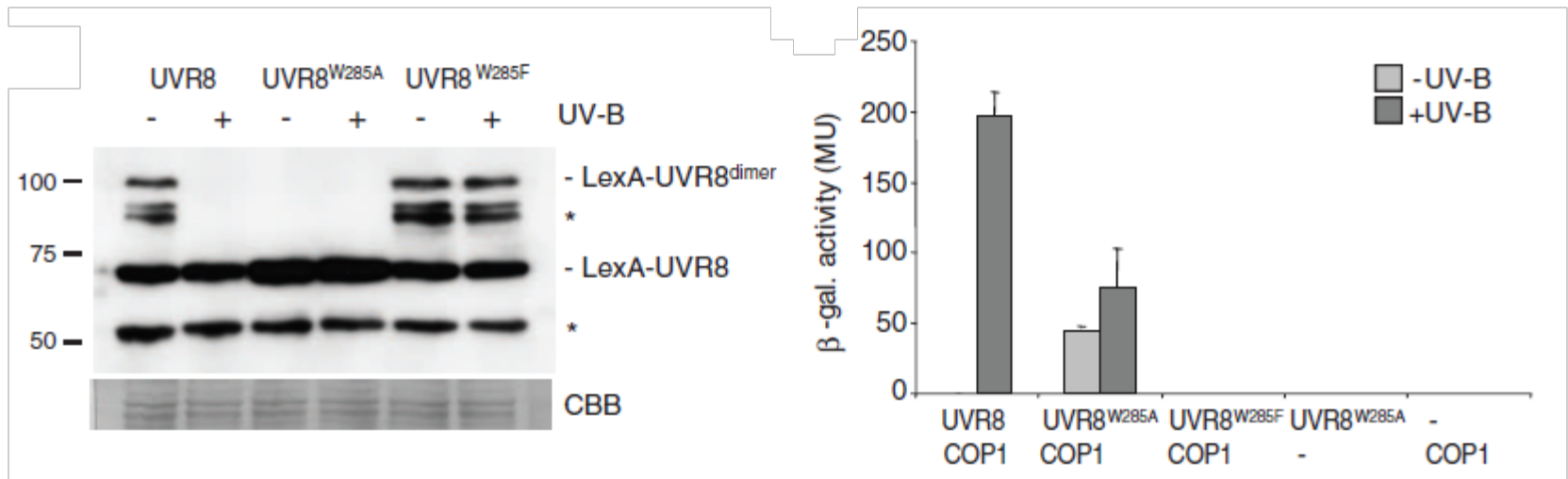


Try(W)

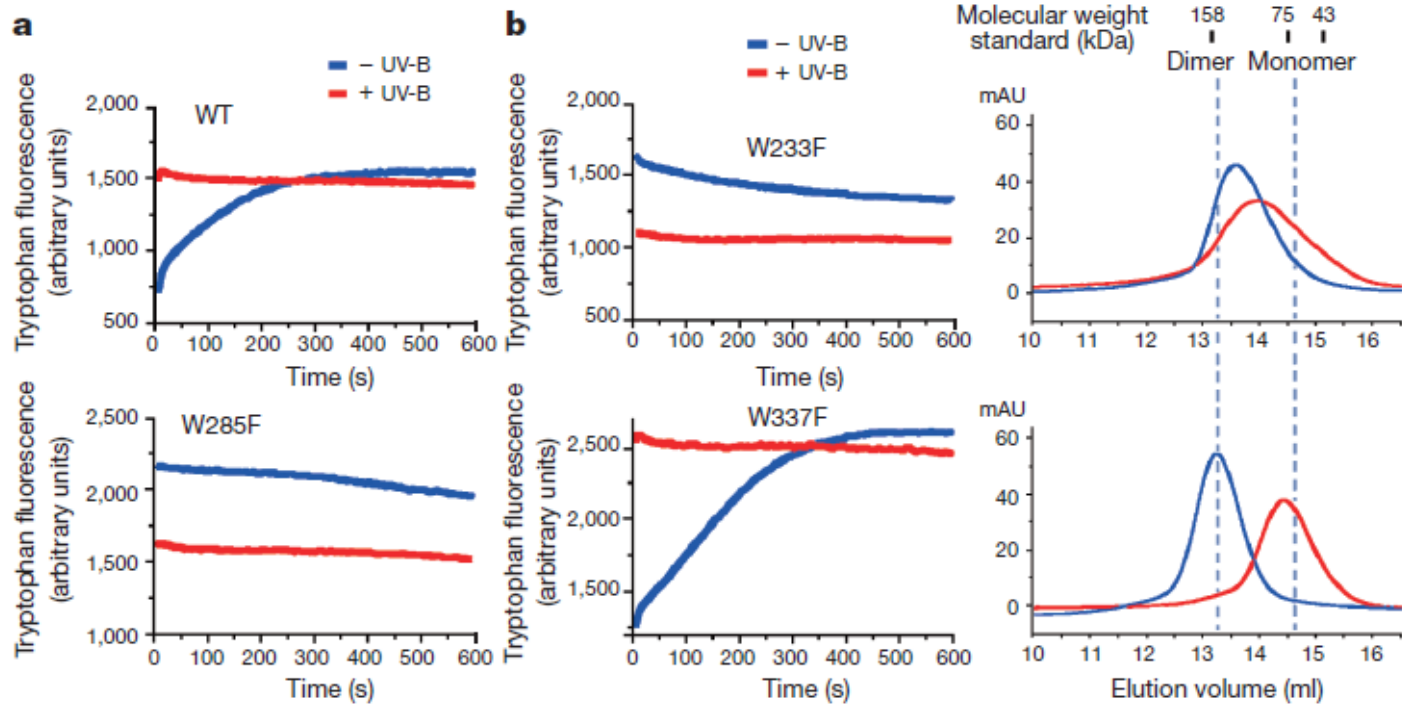


Tyr(Y)

Experimental evidences



Experimental evidences



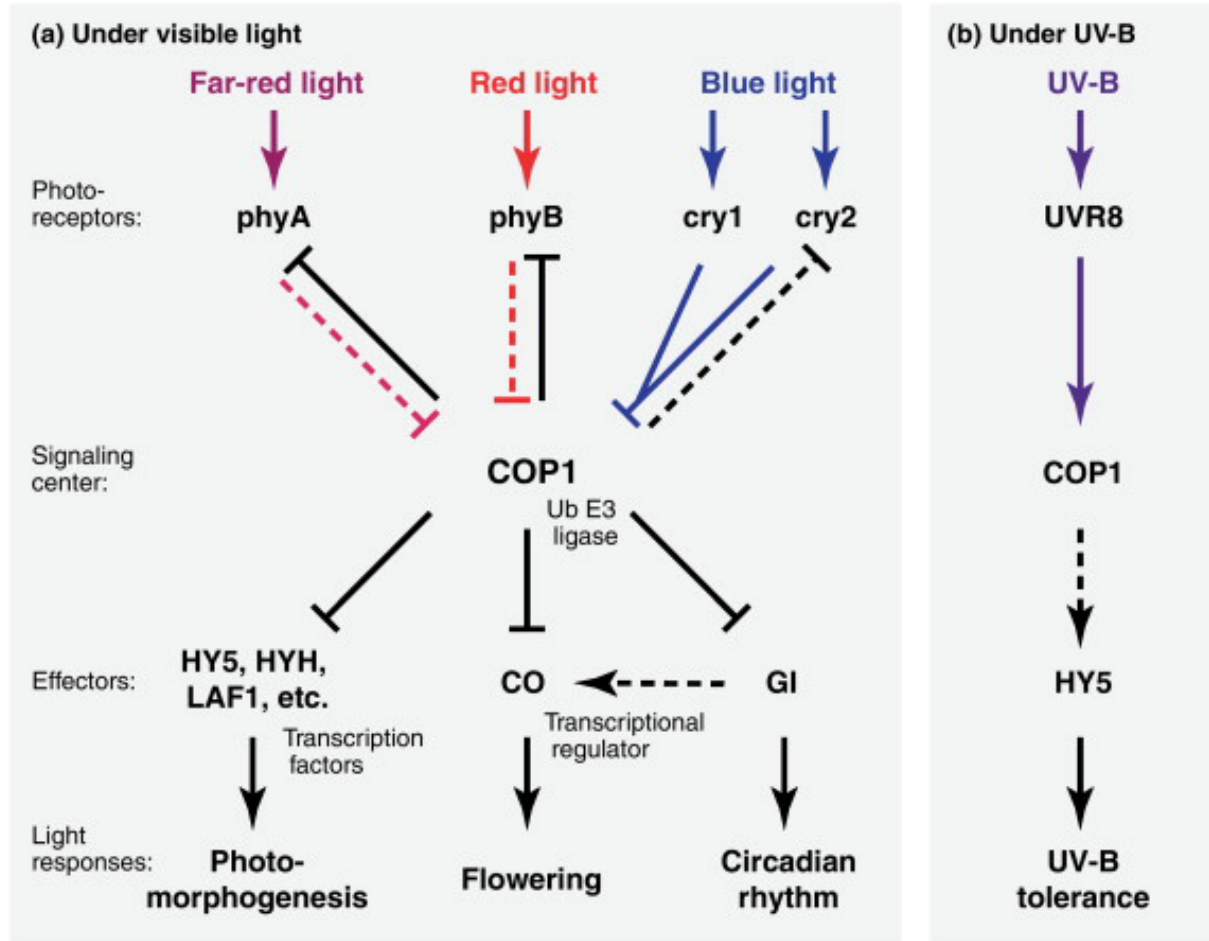
Conclusions

1. The acidic and basic surface patches from one UVR8 core domain associate with the complementarily charged surface patches of another core domain to form a symmetric homodimer. Intermolecular hydrogen bonds and cation- π interactions can stabilize protein structure.
2. These analyses unambiguously identify Trp 285 and Trp 233 collectively as the chromophore for ultraviolet-B perception.

Part II: Analysing how UVR8 positively
regulates HY5 by COP1

Background

Signal paths of COP1



Question

How does the UVR8 positively regulate HY5 by COP1?

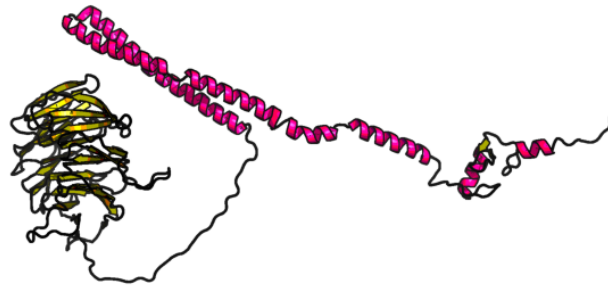
Analysis procedure

Protein modeling prediction

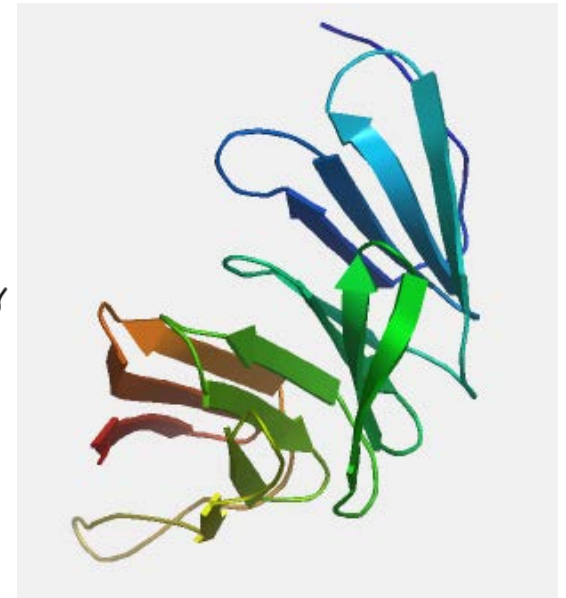
COP1 structure prediction



Phyre2



RaptorX

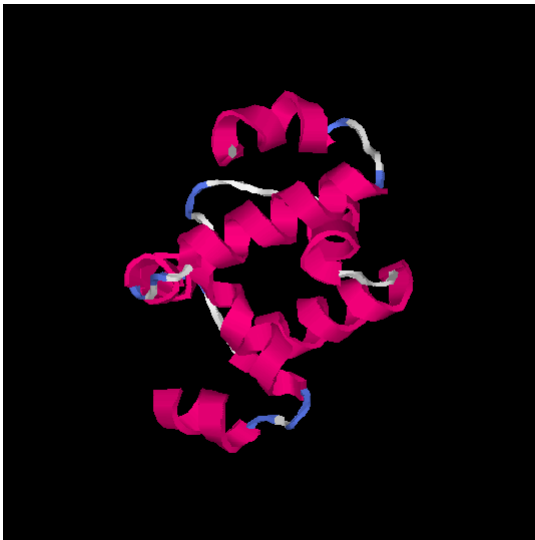


SWISS-MODEL

Analysis procedure

I-TASSER

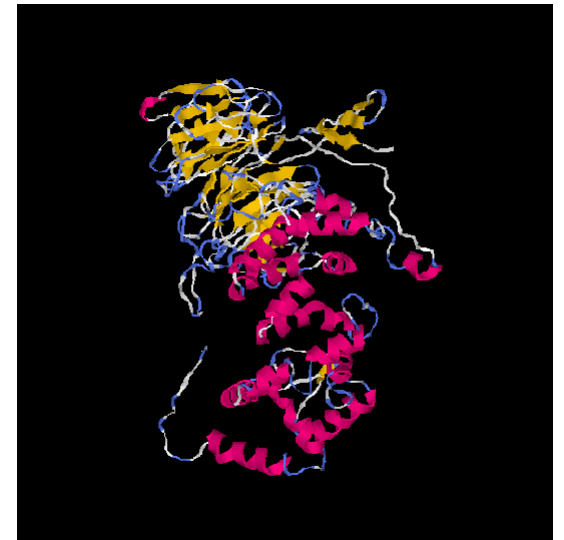
COP1 structure prediction



Model 1



Model 2



Model 3

Analysis procedure

I-TASSER

COP1 structure prediction



Model 4

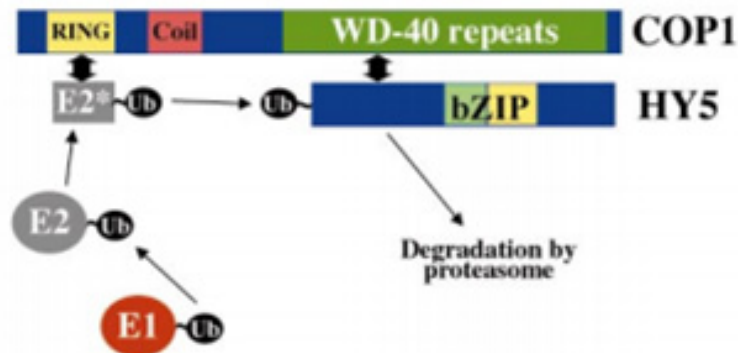
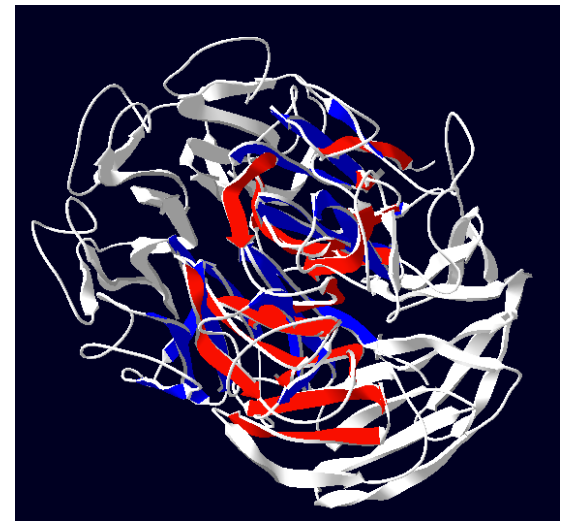
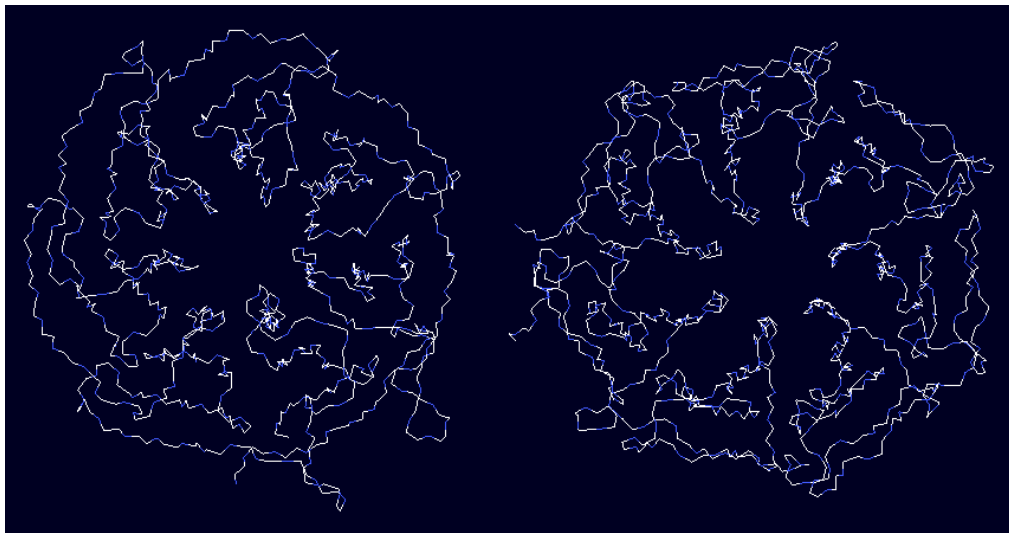


Model 5

Analysis procedure

Fit

COP1 and UVR8 can partially fit



Osterlund *et al.*, 2000

Hypothesis

UVR8 interacts with COP1 basing on the similar WD40 domain at the C-terminal that inhibits COP1 degrading HY5 by blocking COP1 WD40 domain binding HY5.

Acknowledgements

- Prof. Jingchu Luo
- Prof. Xing Wang Deng
- Prof. Liumin Fan
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Thank you!