The structure and function analysis of Cryptochrome
隐花色素蛋白结构和功能分析

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Outline

◆ **Background**

◆ **CRY orthology analysis**

◆ **Paralogy analysis**

◆ **Summary**

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Background

Cryptochromes（隐花色素Cry） are a class of blue light-sensitive flavoproteins found in plants and animals

- The circadian rhythms of plants and animals

- The sensing of magnetic fields in a number of species

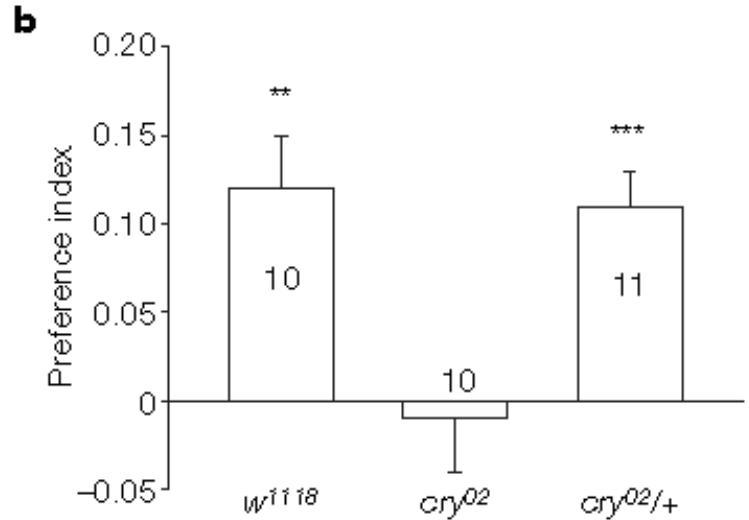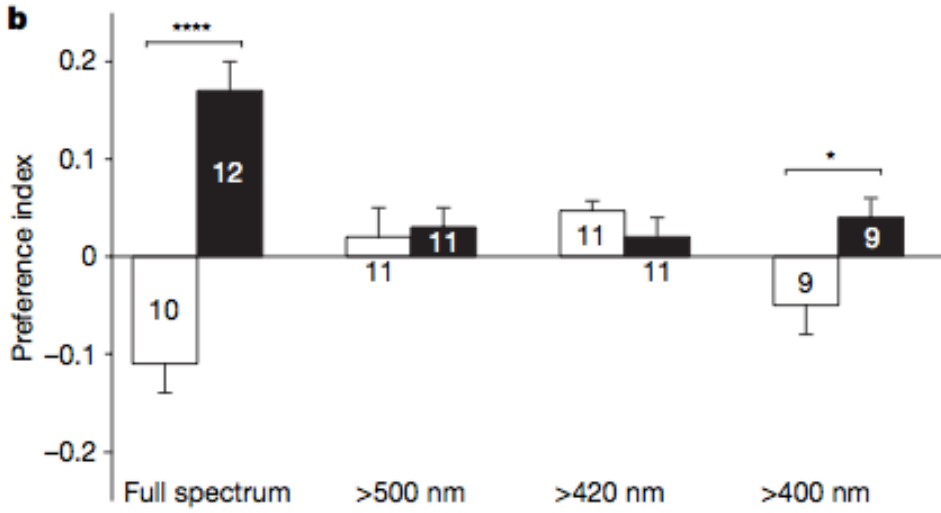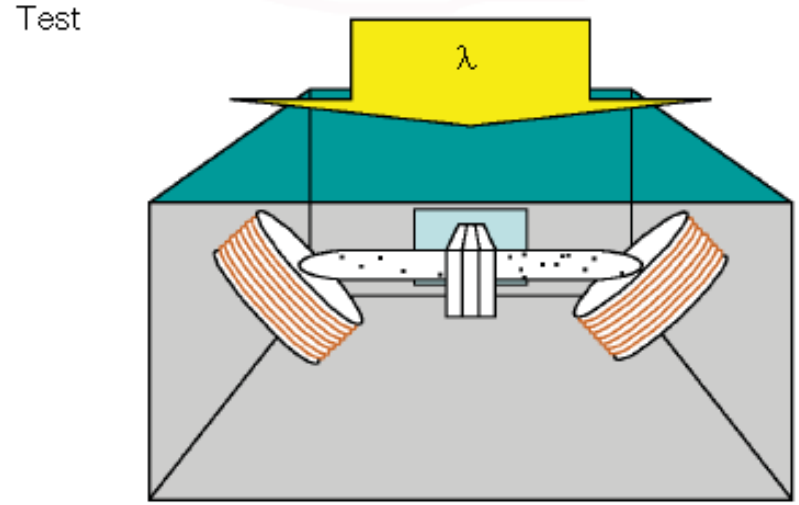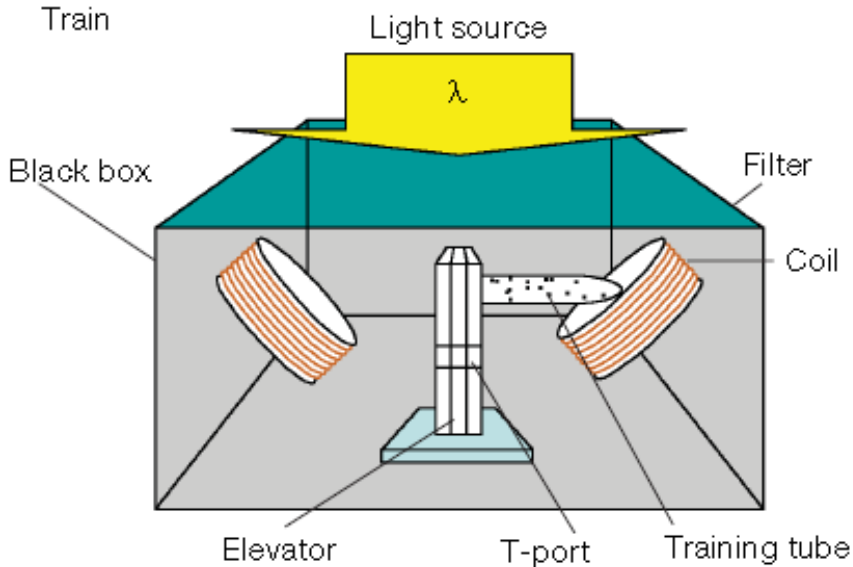# **Cryptochrome**

● The family of photolyases（光裂解酶）/cryptochromes:

- Cyclobutane pyrimidine dimer (CPD) photolyases
- (6–4) Pyrimidine-pyrimidone adduct photolyases
- Cryptochromes (CRY)

黄素腺嘌呤二核苷酸(FAD)
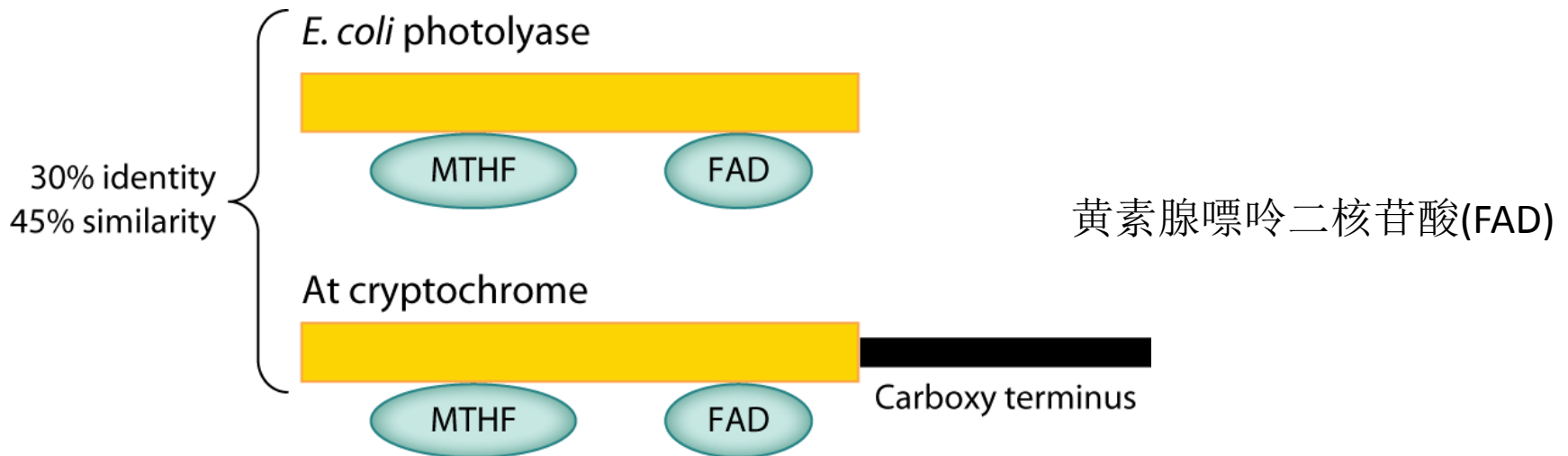
Cryptochrome mediates light-dependent magnetosensitivity in Drosophila
Cry蛋白调控果蝇光依赖性的地磁感应能力

Gegear, Robert J., et al. "." *Nature* 454.7207 (2008): 1014-1018.

Cryptochrome（Cry）
隐花色素

The magnetic compass of the European robin (*Erithacus rubecula*) has been extensively studied by Wiltschko et al. and others. Magnetic field effects in plants (*Arabidopsis thaliana*) have also been observed.
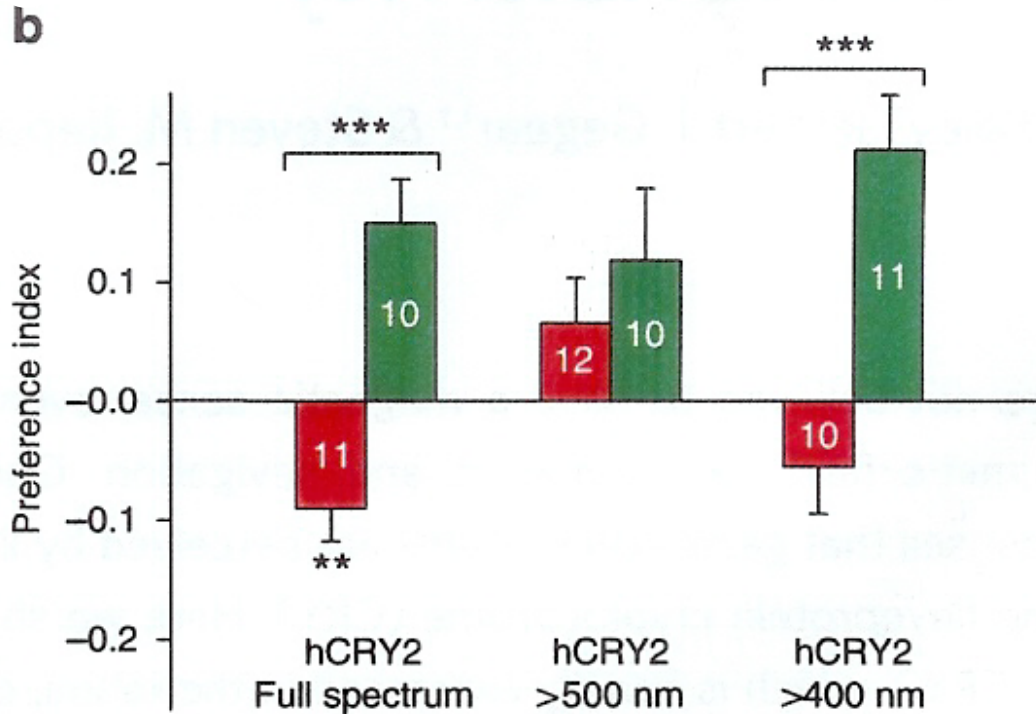

欧洲知更鸟　　　　　　拟南芥

Human Cryptochrome and Magnetic Sensing
人类Cry与地磁感应

Foley, Gegear & Reppert 2011
Nature Comm ncomms1364:

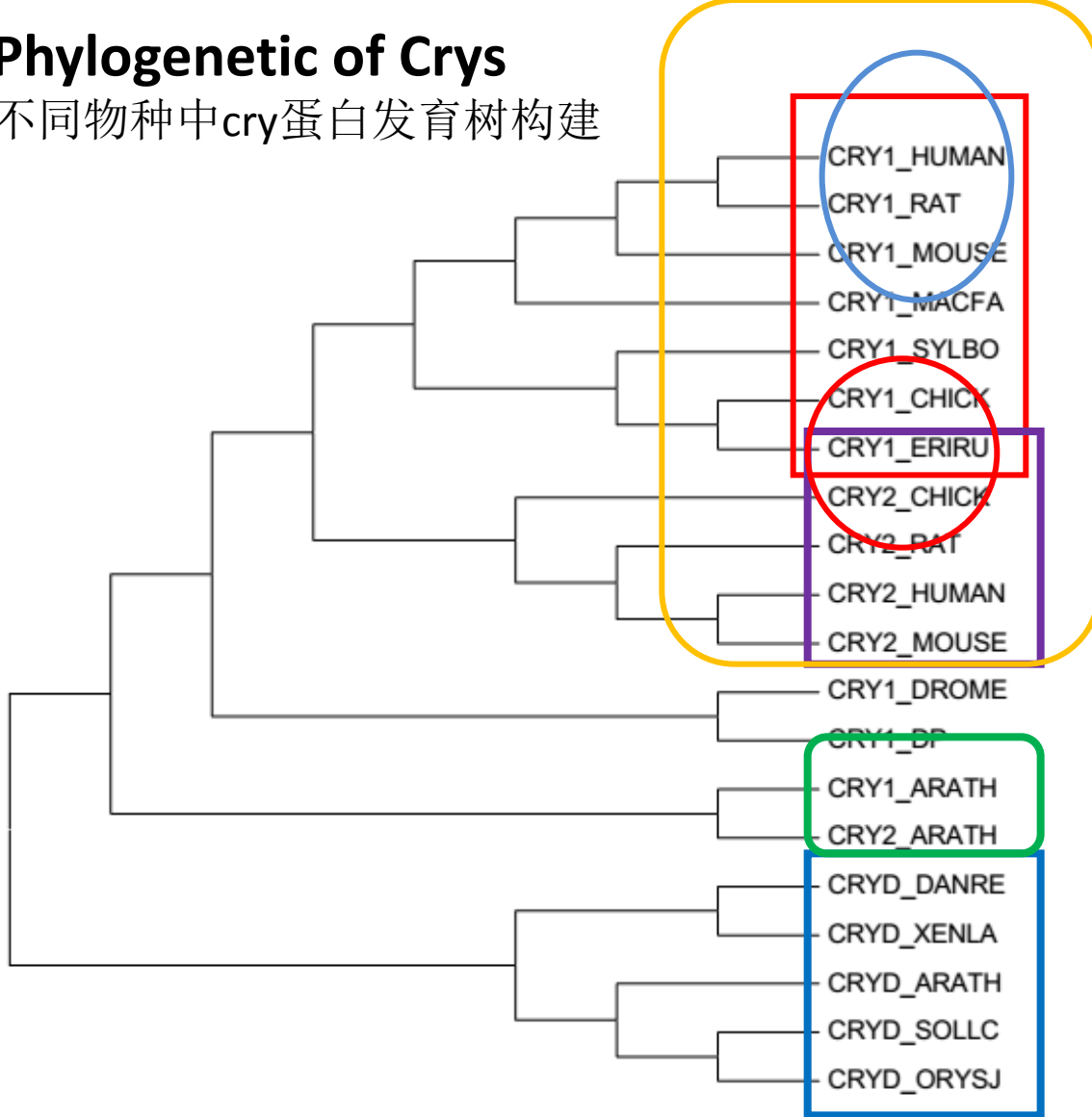"**Human cryptochrome exhibits light-dependent magnetosensitivity**"

Findings:
- (i) CRY-deficient flies showed no MF response;
- (ii) Human CRY-rescued flies showed light-dependent magnetosensitivity: positive response under full spectrum light was blocked at >500 nm but partially restored at >400 nm.

Outline

Phylogenetic of Crys

不同物种中cry蛋白发育树构建

- **CRY1 CRY2 CRYD**

- **Evolutionary distance**
  Mammal   Birds

- **Plants** vs **Animals**

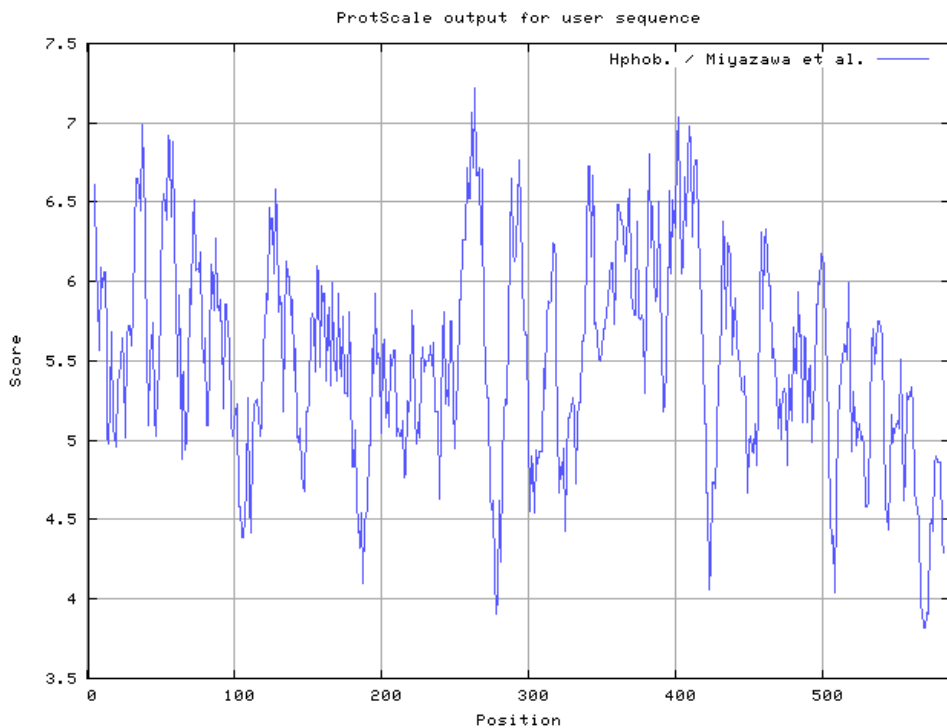## High conservation among different species

Align: muscle
Phylogeny: Maximum likelihood
Test of Phylopeny: Bootstrap
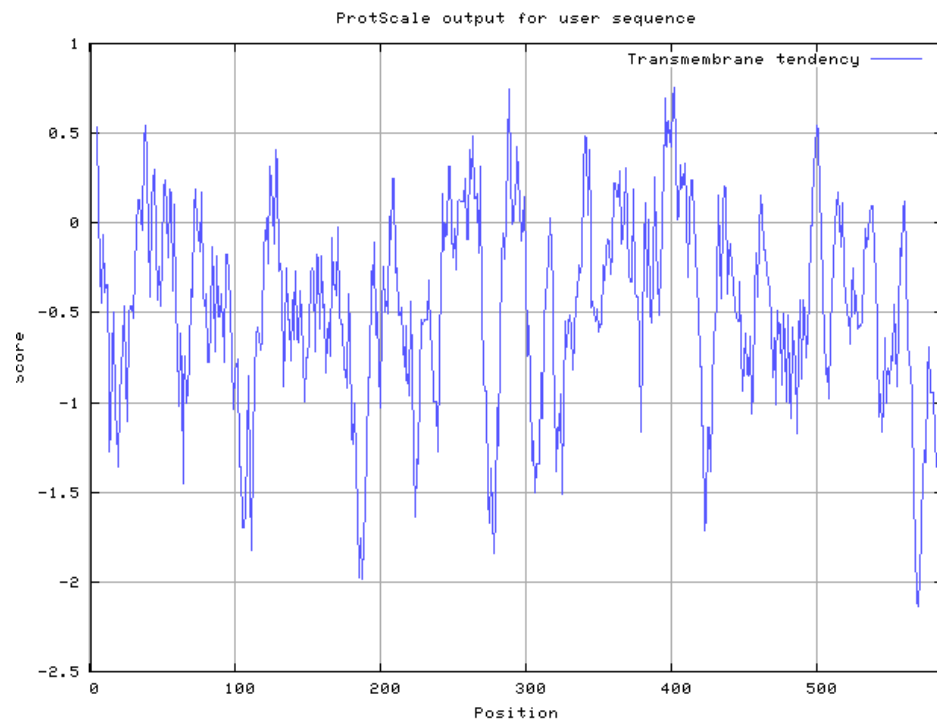
by MEGA and Uniprot

Alignment of dCry and hCry
人和果蝇Cry蛋白序列比对

Conserved sites

LENGTH	SCORE	IDENTITY	SIMILARITY	GAPS
636	1001.5	218/636 (34.3%)	308/636 (48.4%)	144/636 (22.6%)

Identity:218/636(34.3%)
Similarity:308/636(48.4%)

by Needle

亲疏水

Hphob. / Miyazawa et al

跨膜预测

Transmembrane tendency

hCRY蛋白

By ExPASy

Signal Protein

Subcellular location

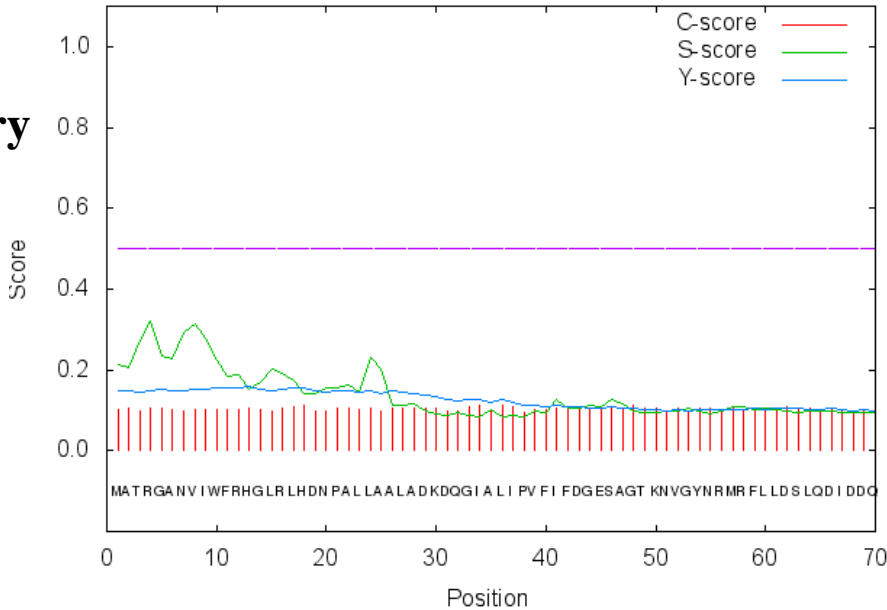**dCry**
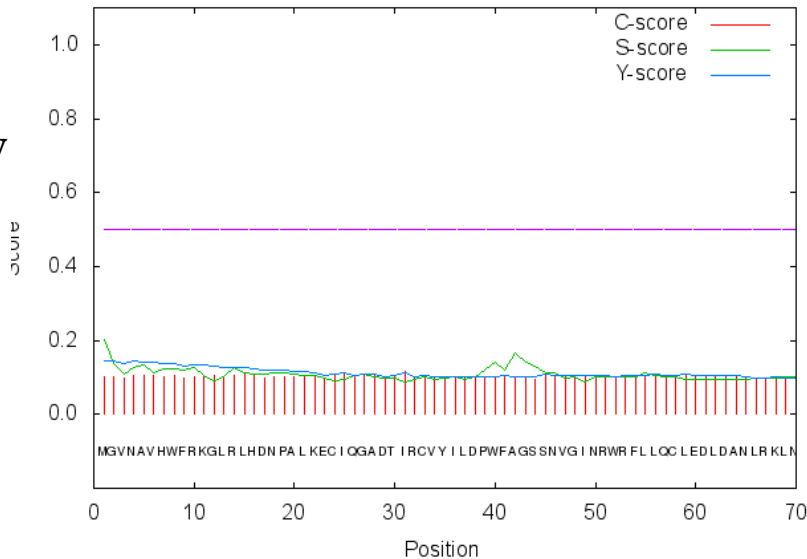
SignalP-4.1 prediction (euk networks): gi_24648152_ref_NP_732407.1_

hCry

SignalP-4.1 prediction (euk networks): gi_4758072_ref_NP_004066.1_


```
### targetp v1.1 prediction results ###############################
Number of query sequences:  1
Cleavage site predictions not included.
Using NON-PLANT networks.

Name                 Len       mTP    SP   other  Loc  RC
------------------------------------------------------------
sp_O77059_CRY1_DROME  542      0.497 0.094 0.270   M    4
------------------------------------------------------------
cutoff                         0.000 0.000 0.000
```

M指的线粒体（**mTP**）
S指的分泌途径（**SP**）
其他位置（other）

```
### targetp v1.1 prediction results ###############################
Number of query sequences:  1
Cleavage site predictions not included.
Using NON-PLANT networks.

Name                 Len       mTP    SP   other  Loc  RC
------------------------------------------------------------
Sequence              7        0.057 0.032 0.974   _    1
------------------------------------------------------------
cutoff                         0.000 0.000 0.000
```

By SignalP 4.1 Server and TargetP 1.1 Server
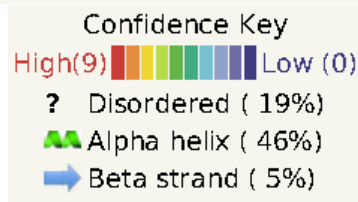
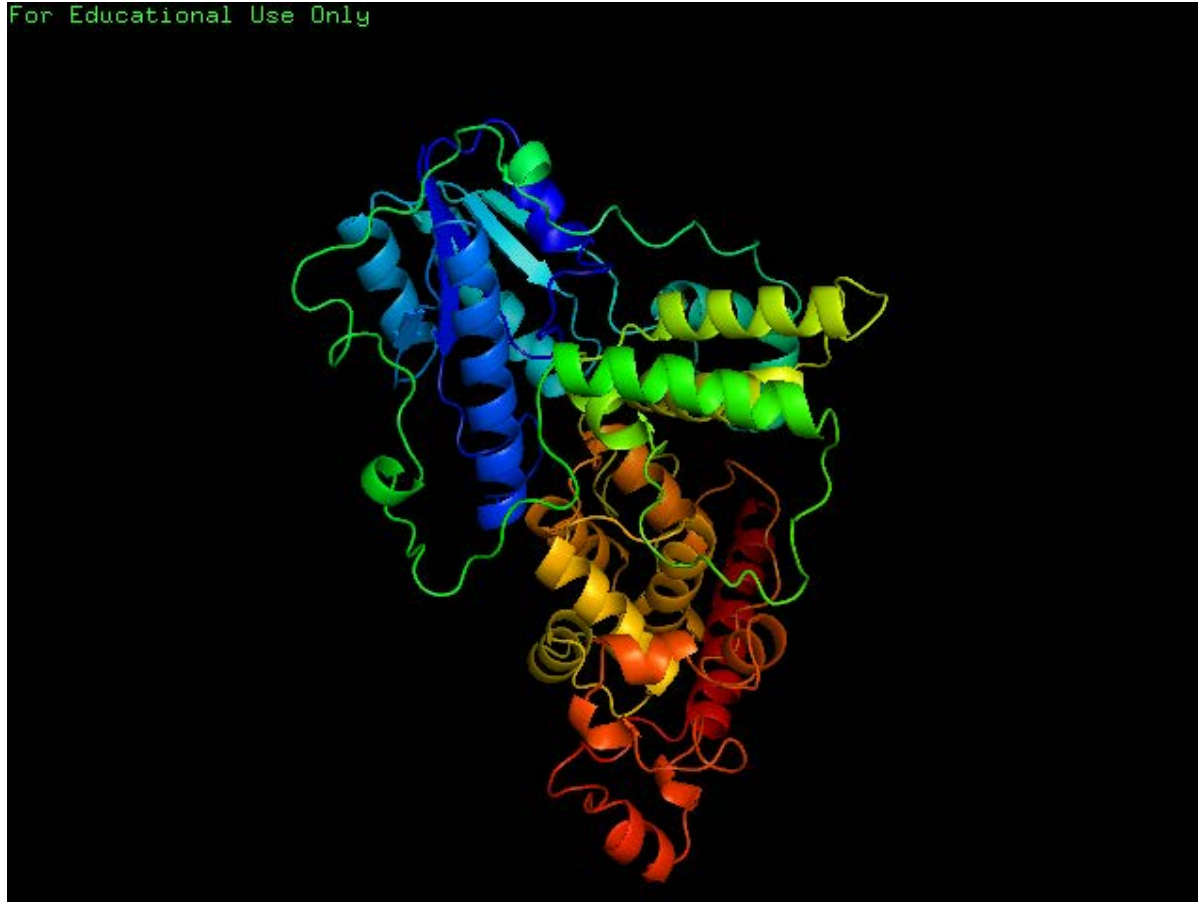# 3D structure of dCry
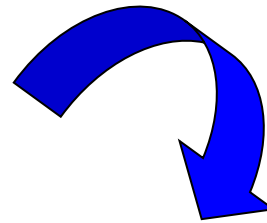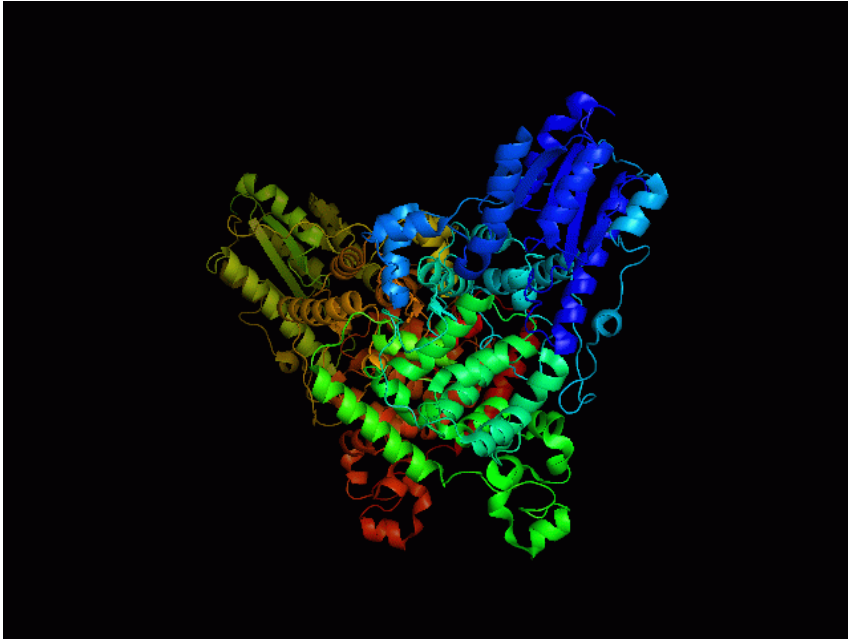
FAD 与色氨酸三联体
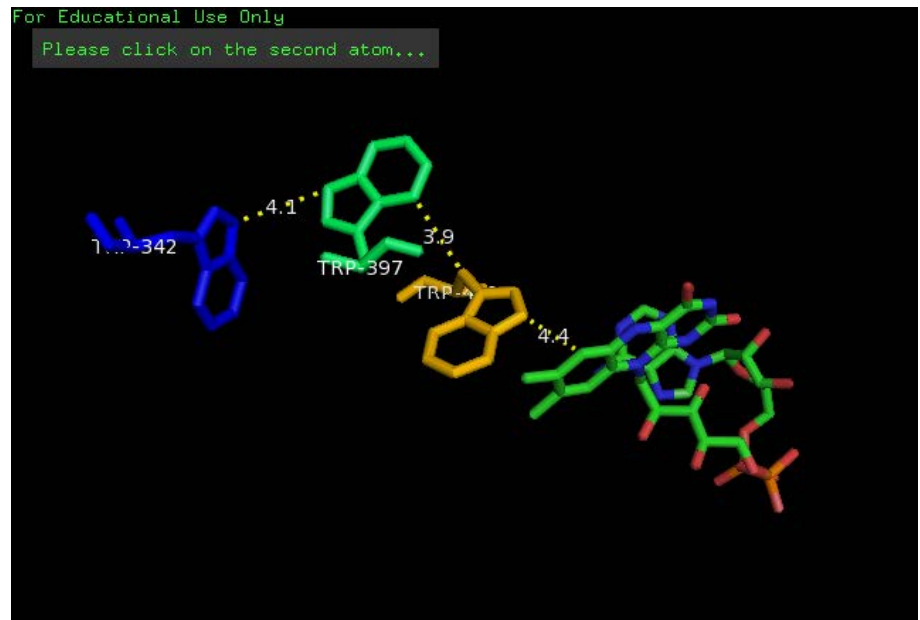
By Pymol

感磁机制：自由基电子对假说
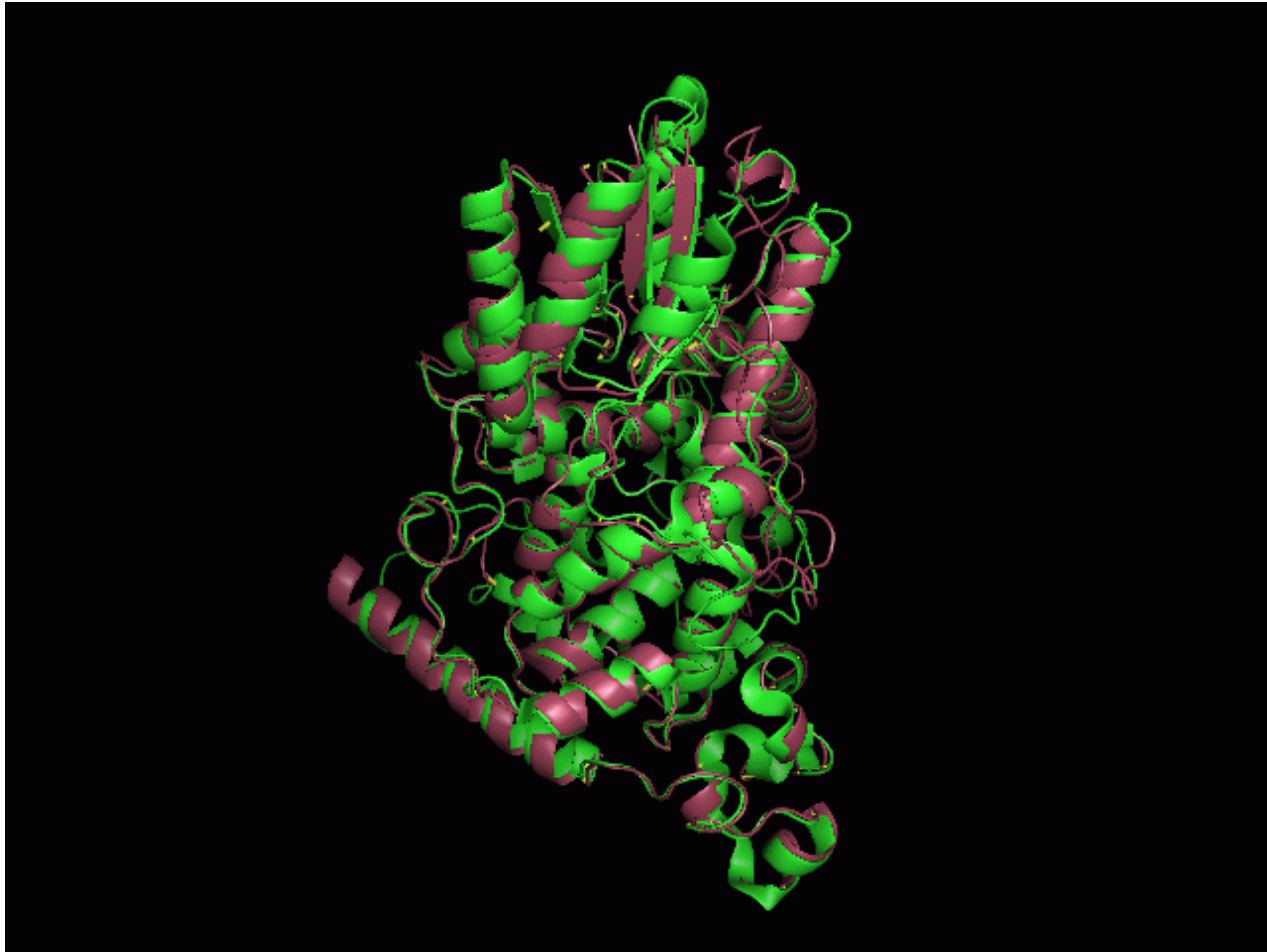
Secondary structure prediction of hCry
hCRY蛋白二级结构预测

by Phyre
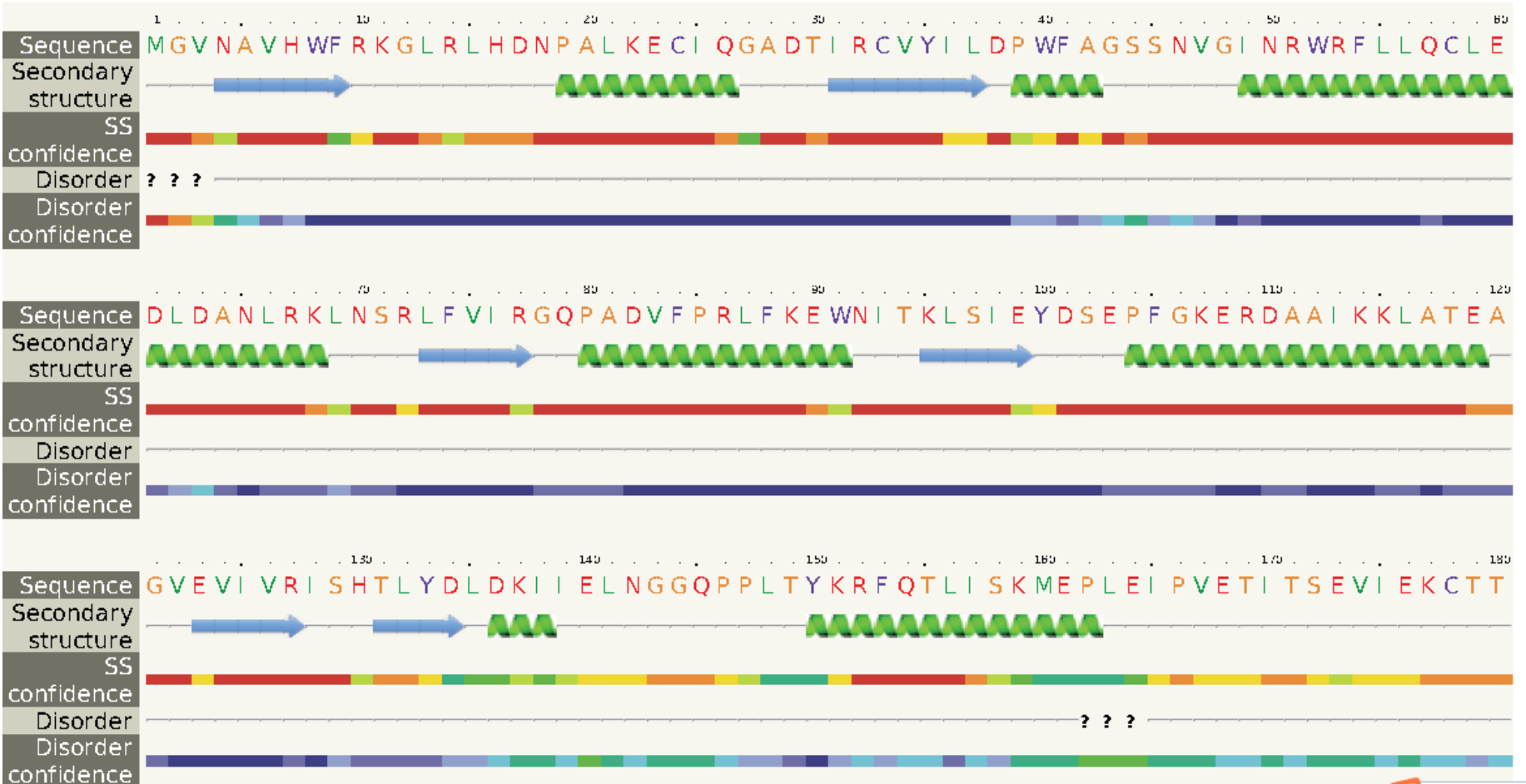
Predicted 3D structure of hCry
hCRY蛋白3D结构预测

By Pymol

Alignment of dCry and hCry
人和果蝇Cry蛋白3D结构的比对

green:dCry
purple:hCry

By Pymol

Outline

Comparison of dCRY and 6-4 dPL
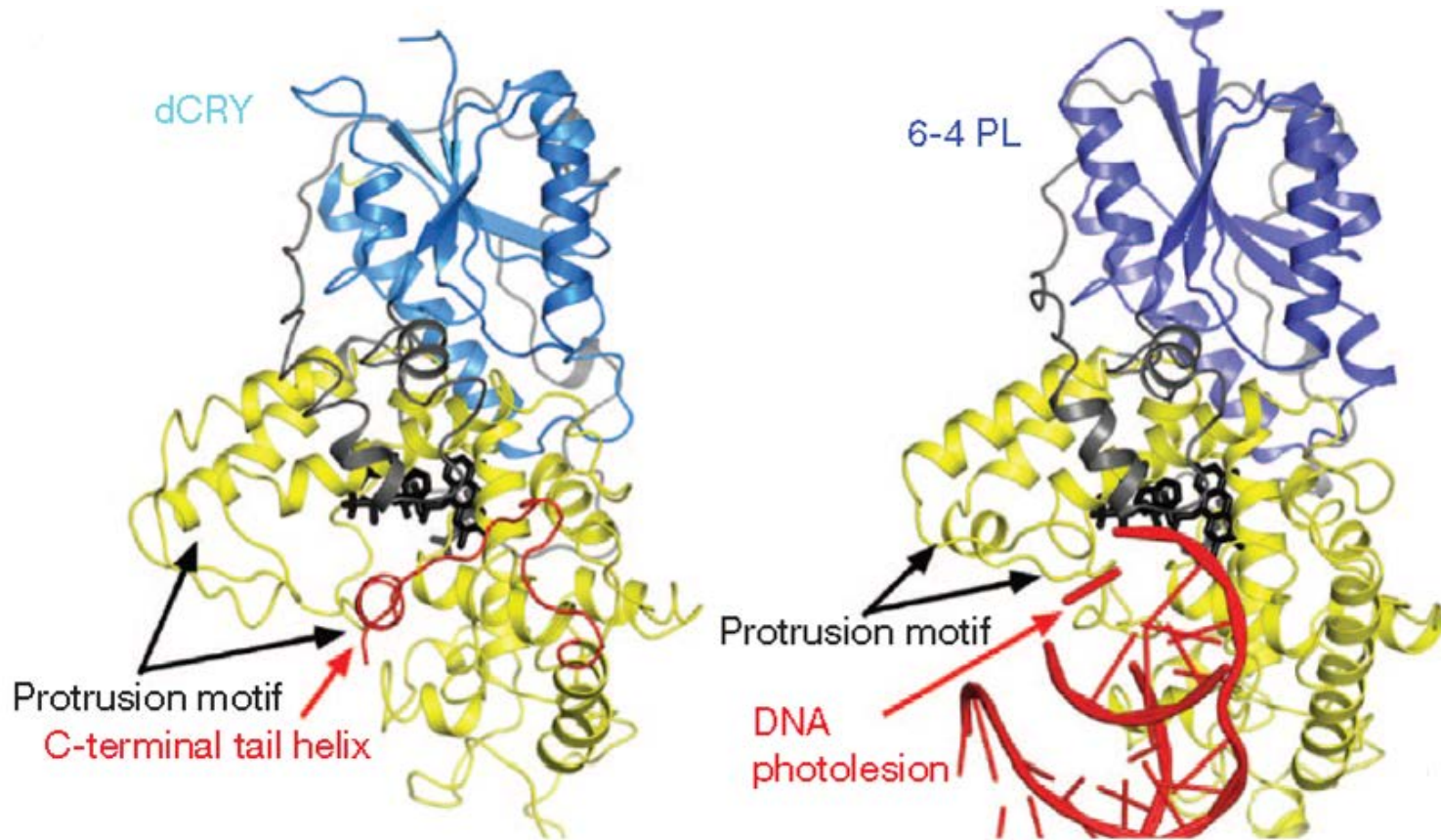
Cry无诱导的DNA 损伤修复功能
dPL没有磁感应的能力

blue:N-terminal α/β domain
yellow:C-terminal helical domain
grey:linker

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Summary

- **CRY has high conservation among species**

- **The similarity of hCRY and dCRY is high, while the role of hCRY in human is still unknown**

- **By comparing the 3D structure of dCRY with 6-4 dPL, suggested the family relationship**

Acknowledgement

- Thanks for our group members

- Thanks for pro. Luo＇s hard work

- Thanks for the helping from the assistants and the other groups

Thanks for your attention!