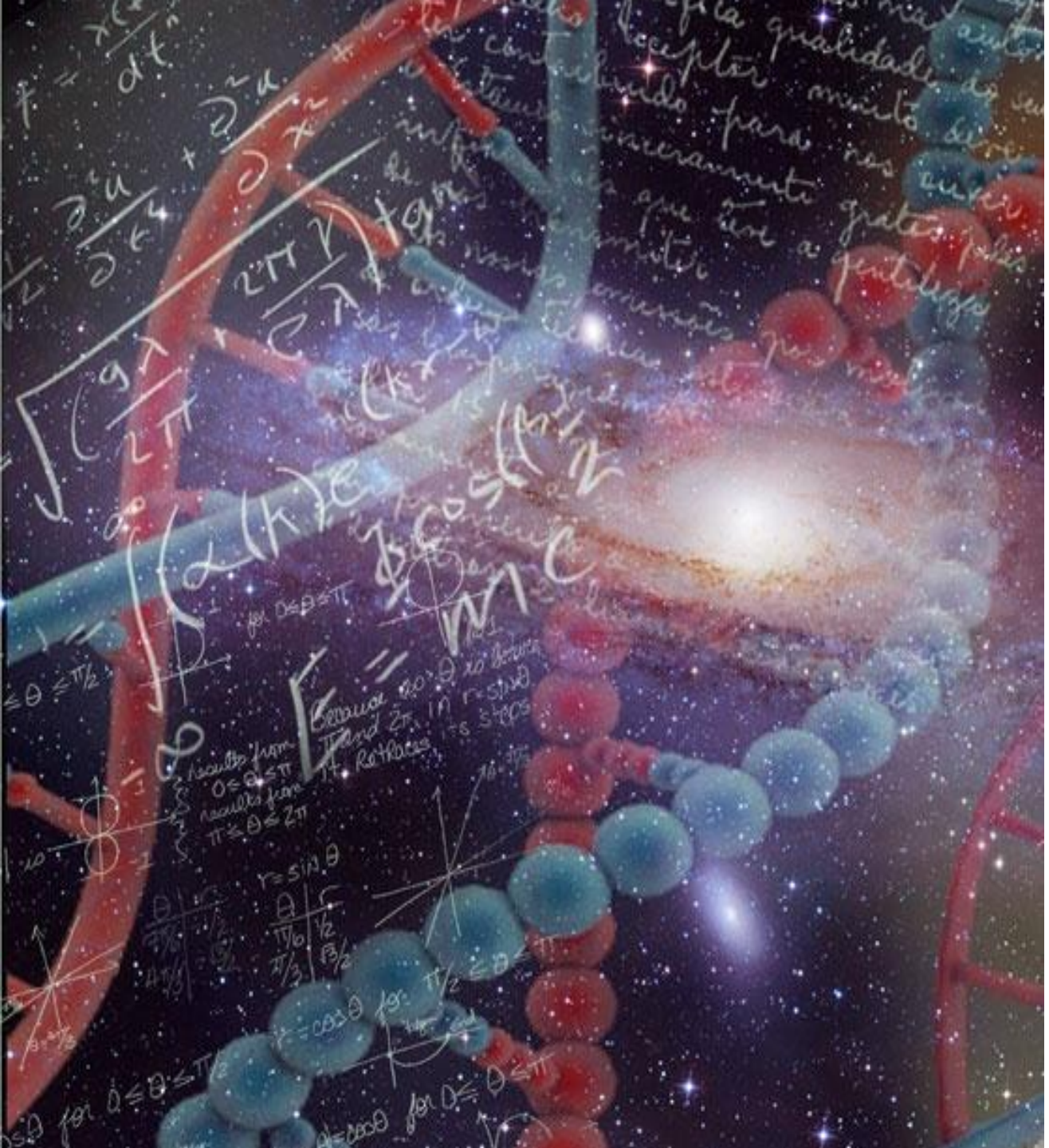


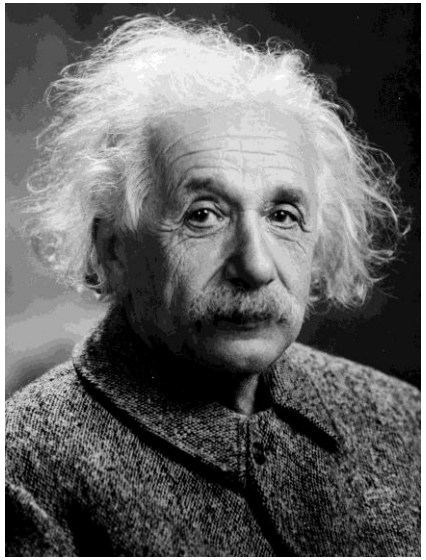
Ταξιδεύοντας στο μαγικό κόσμο της Κβαντικής Βιολογίας

Βερονίκη Τσερντίντσεβα

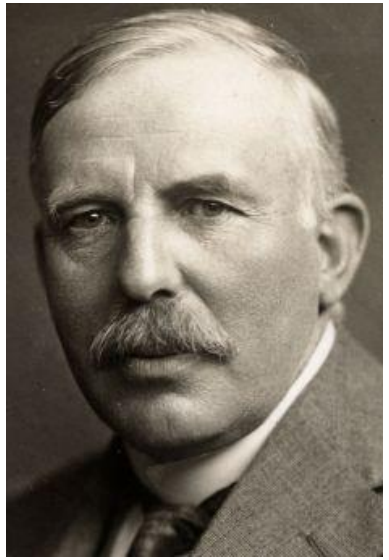
5η Ημερίδα Χημείας

Απρίλιος 2017

M. Planck



A. Einstein



E. Rutherford

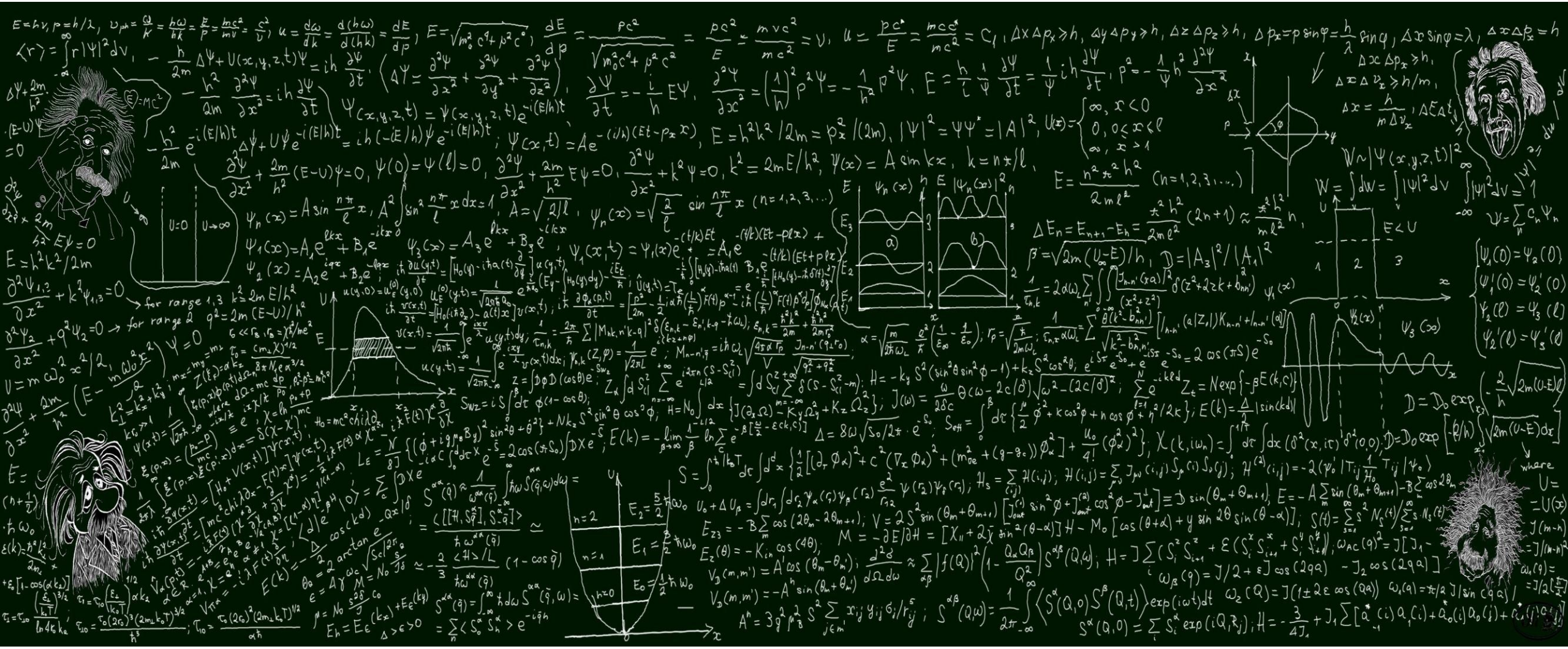
N. Bohr

W. Pauli

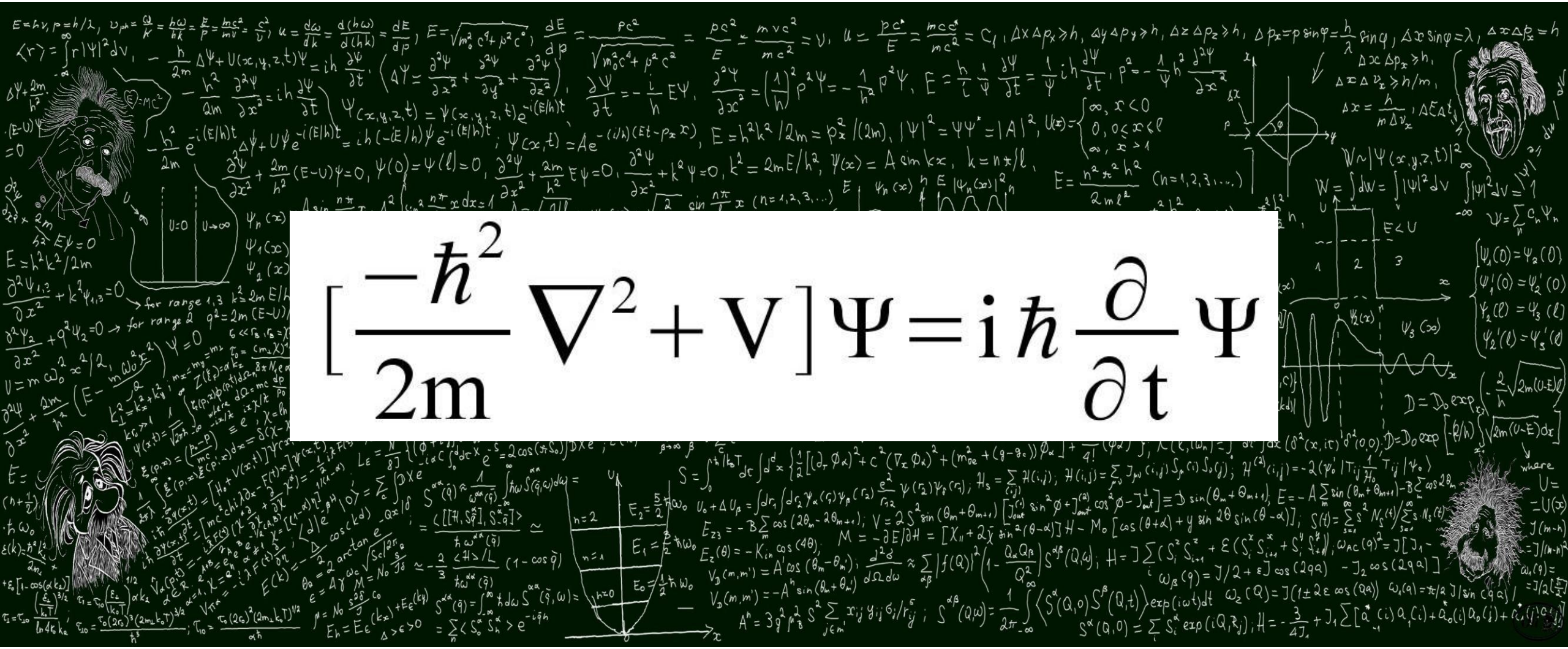
W. Heisenberg

E. Schrödinger

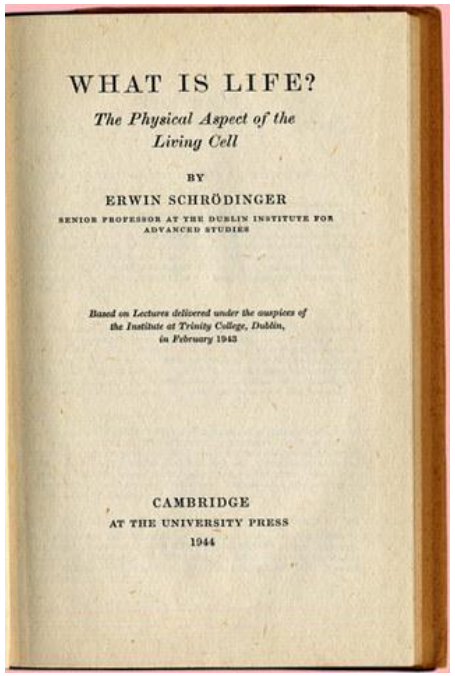
Κβαντική Μηχανική



Κβαντική Μηχανική



$$\left[\frac{-\hbar^2}{2m}\nabla^2 + V\right]\Psi = i\hbar\frac{\partial}{\partial t}\Psi$$



WHAT IS LIFE?

The Physical Aspect of the Living Cell

BY

ERWIN SCHRÖDINGER

SENIOR PROFESSOR AT THE DUBLIN INSTITUTE FOR ADVANCED STUDIES

Based on Lectures delivered under the auspices of the Institute at Trinity College, Dublin, in February 1943

CAMBRIDGE

AT THE UNIVERSITY PRESS

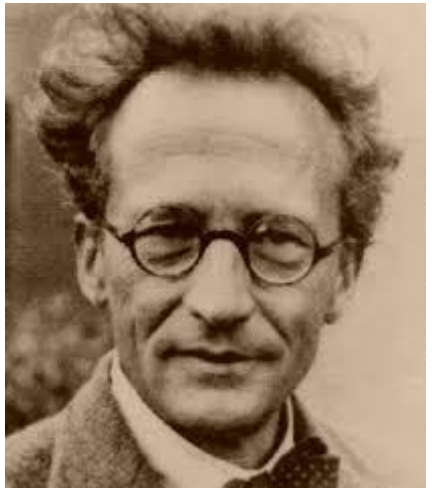
1944

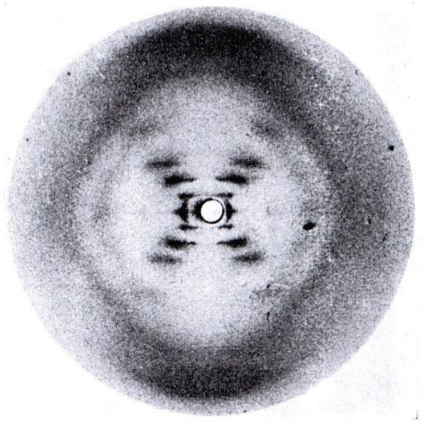
1944: Erwin Schrödinger

«γονίδια ως απεριοδικοί κρύσταλλοι»

&

«μεταλλαγές ως κβαντικά άλματα»

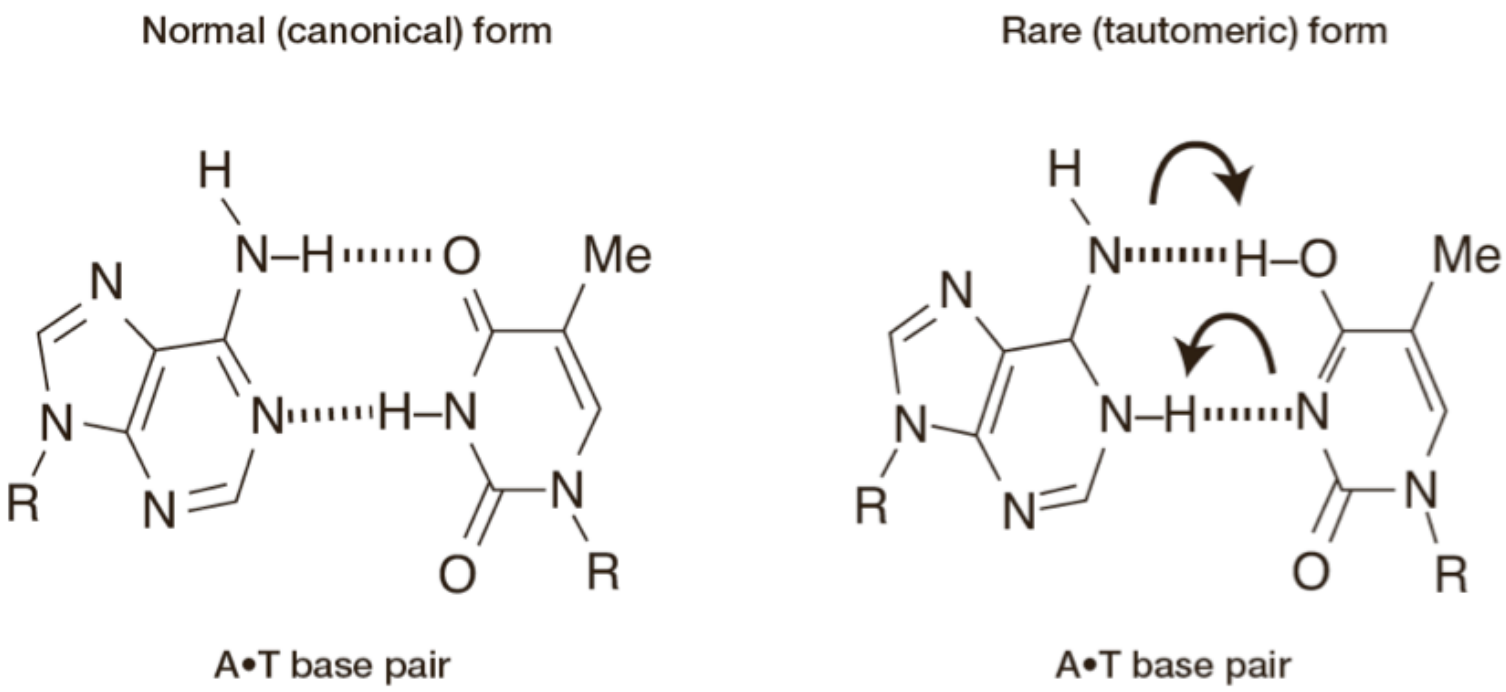




1953: James Watson, Francis Crick, & Rosalind Franklin

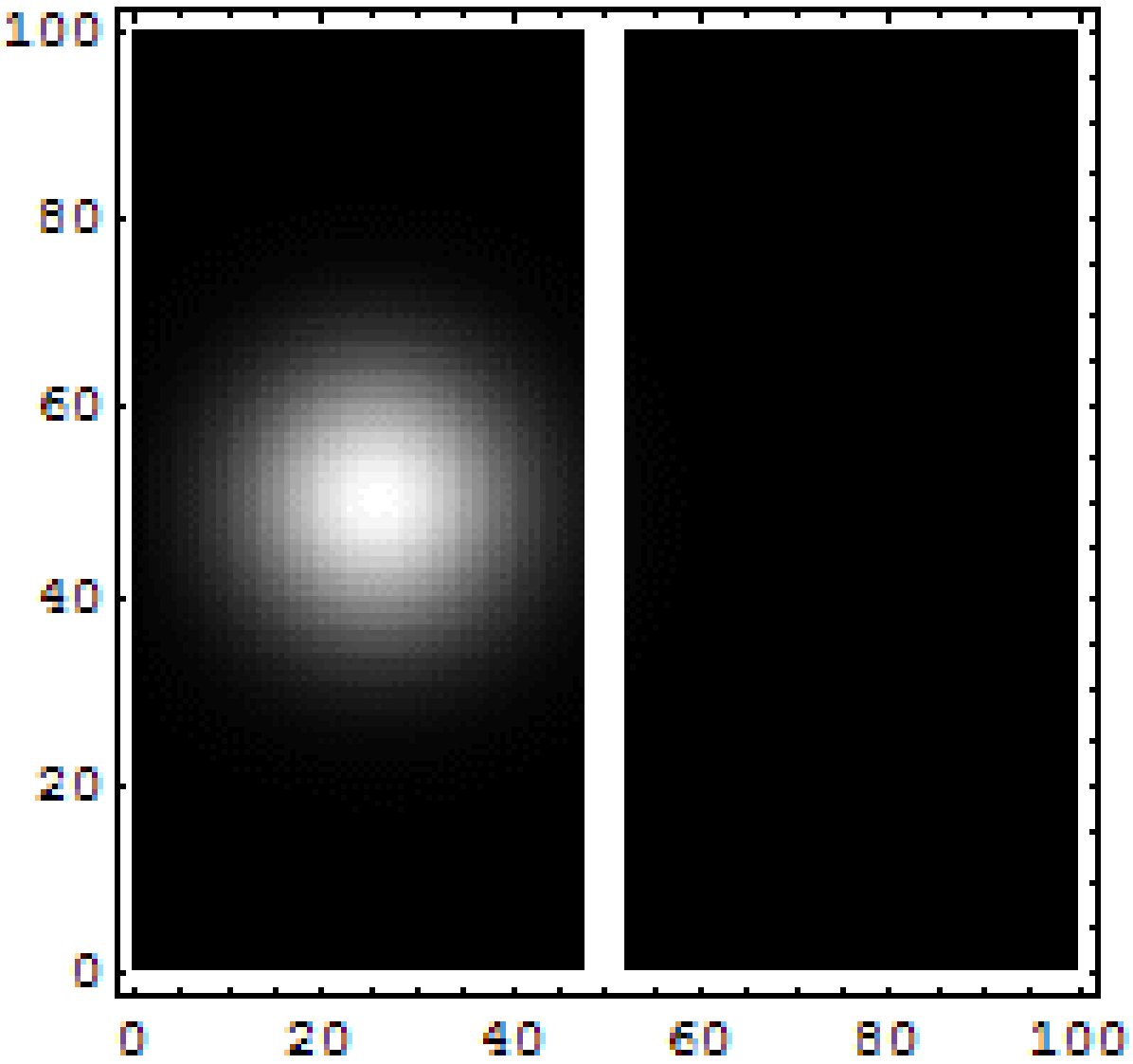
ανακάλυψη διπλής έλικας DNA

Μεταλλάξεις

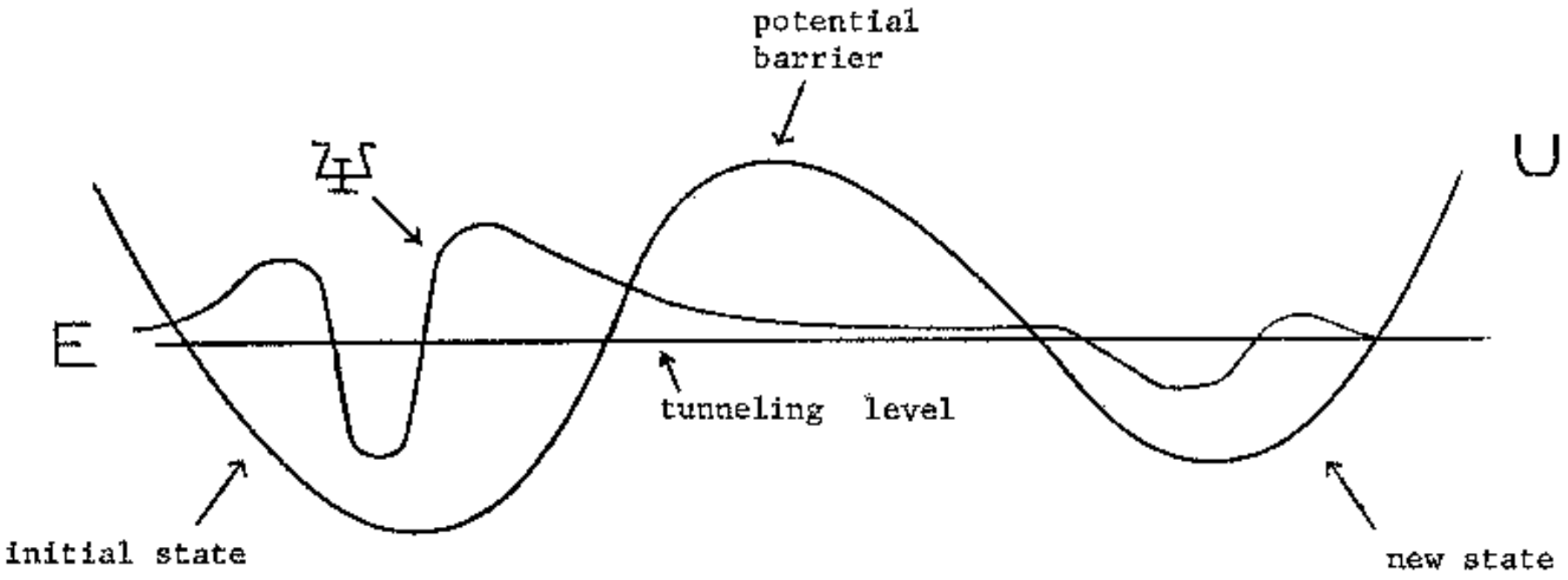


Stevenson P. D. et al, *Phys. Chem. Chem. Phys.*, **2015**, 17, 13034-13044

Φαινόμενο Σήραγγας



www.sciencefacts.de/physik/quantenmechanik

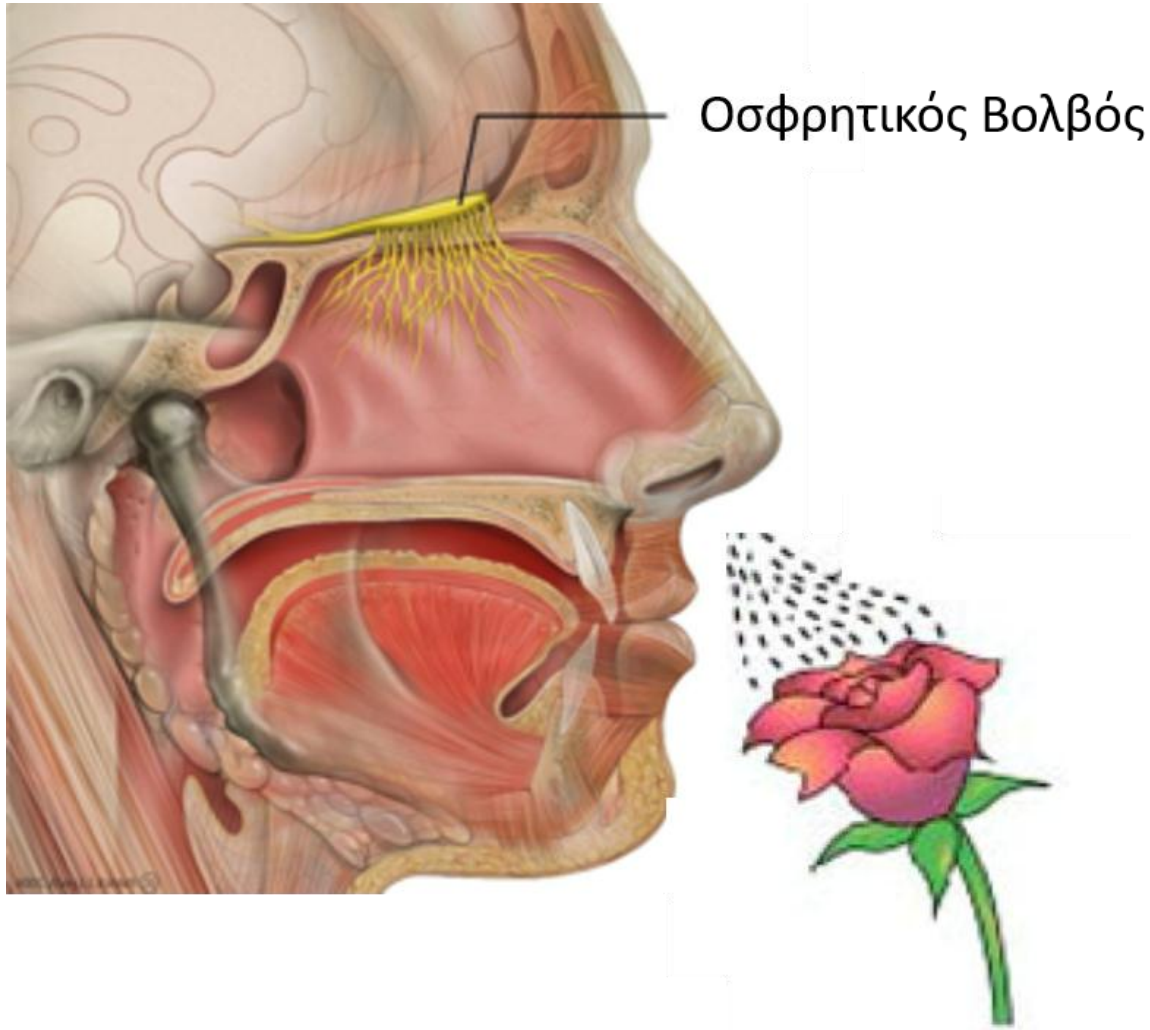


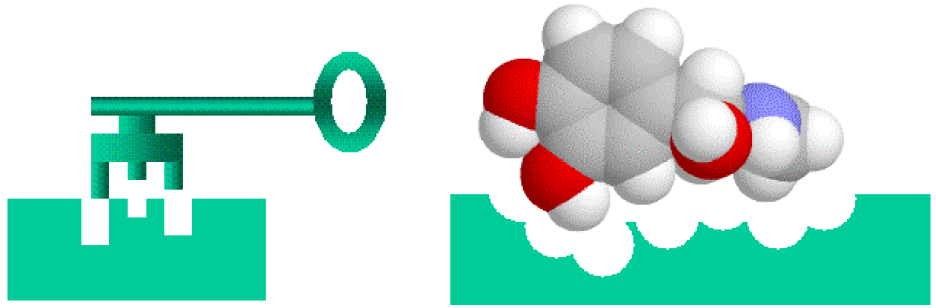
Wolfe M., *Quantum Tunneling in DNA*, **2013**

$$|\Psi_G\rangle = \alpha|\Phi_{\text{not tun.}}\rangle|C\rangle + \beta|\Phi_{\text{tun.}}\rangle|T\rangle$$

McFadden J. et al, *BioSystems*, **1999**, 50, 203-211

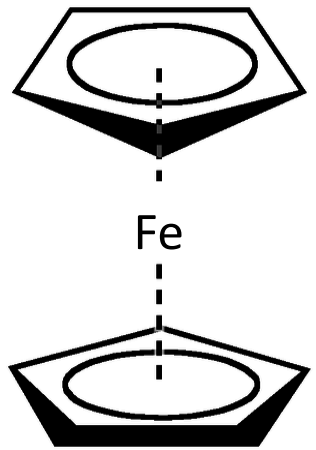
Όσφρηση

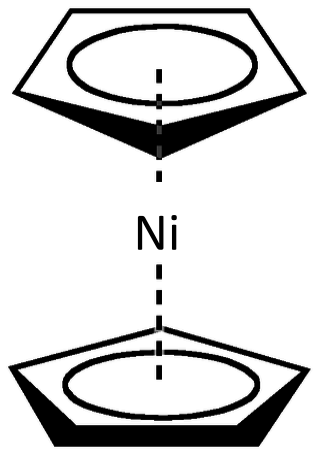


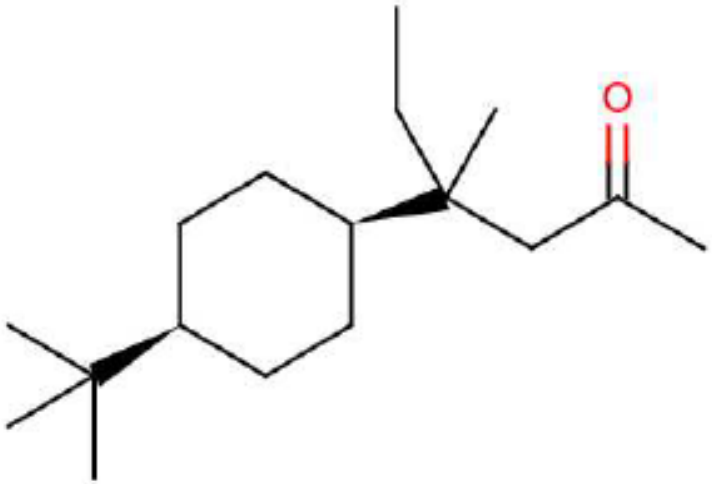


Μοντέλο «κλειδιού-κλειδαριάς»

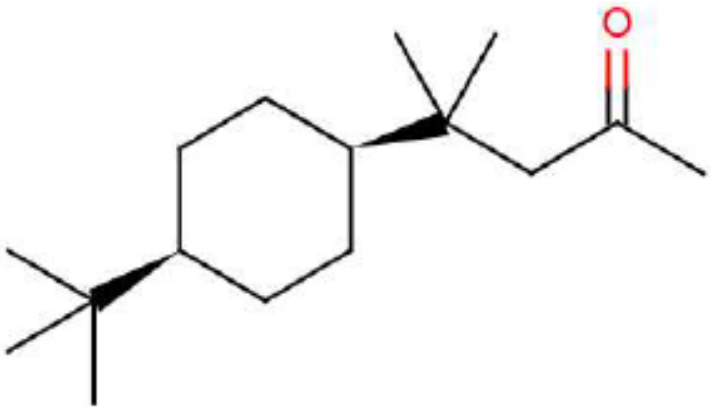
?



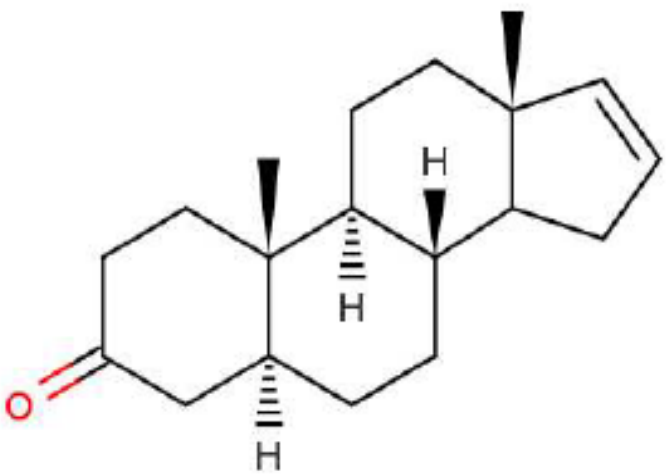




(4-(4-τερτ-βουτυλκυκλοεξυλ)-4-μεθυλεξαν-2-όνη)



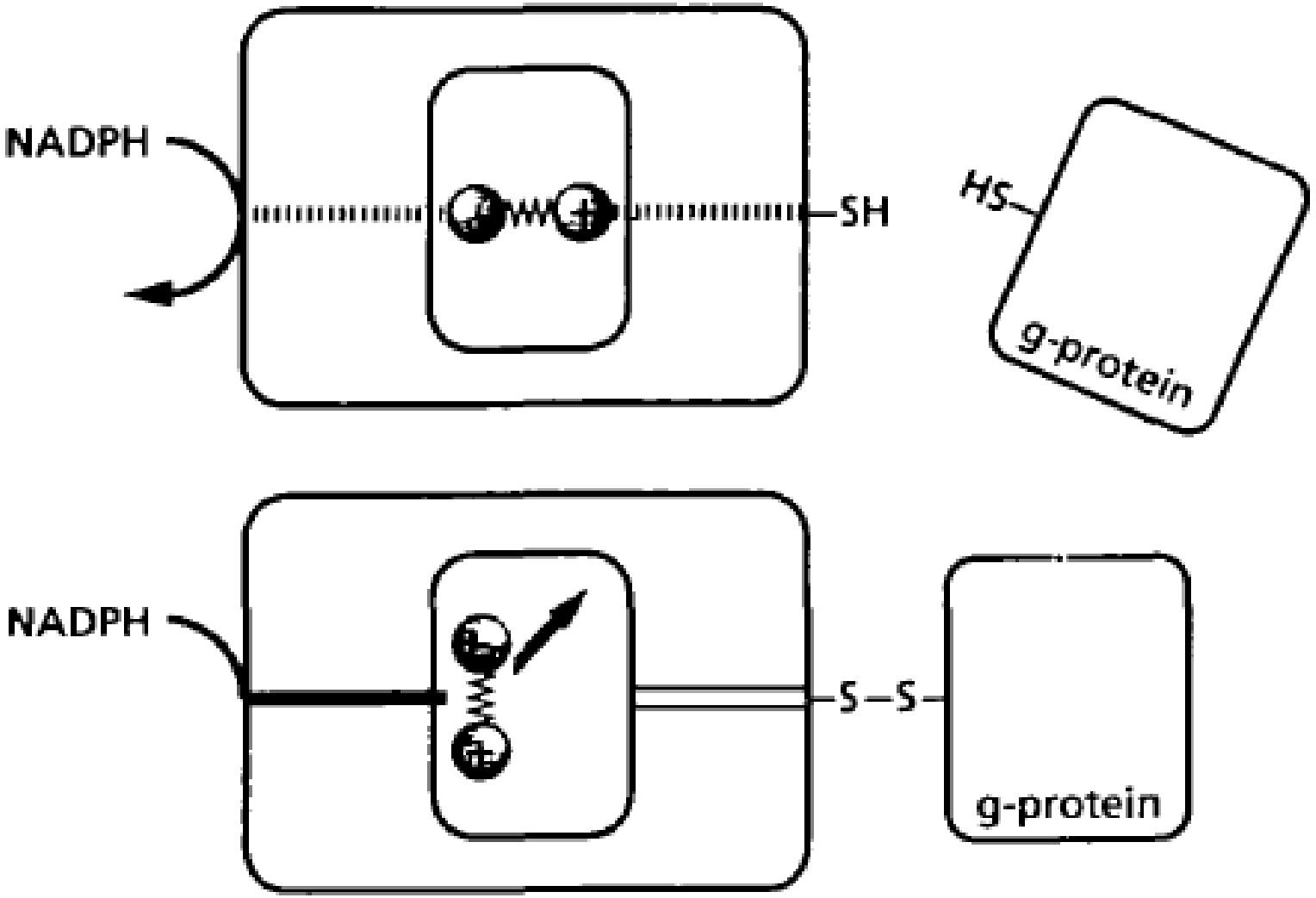
(4-(4-τερτ-βουτυλκυκλοεξυλ)-4-μεθυλπενταν-2-όνη)



5α-ανδροστερ-16-εν-3-όνη

Προτεινόμενος Μηχανισμός

Turin, 1996



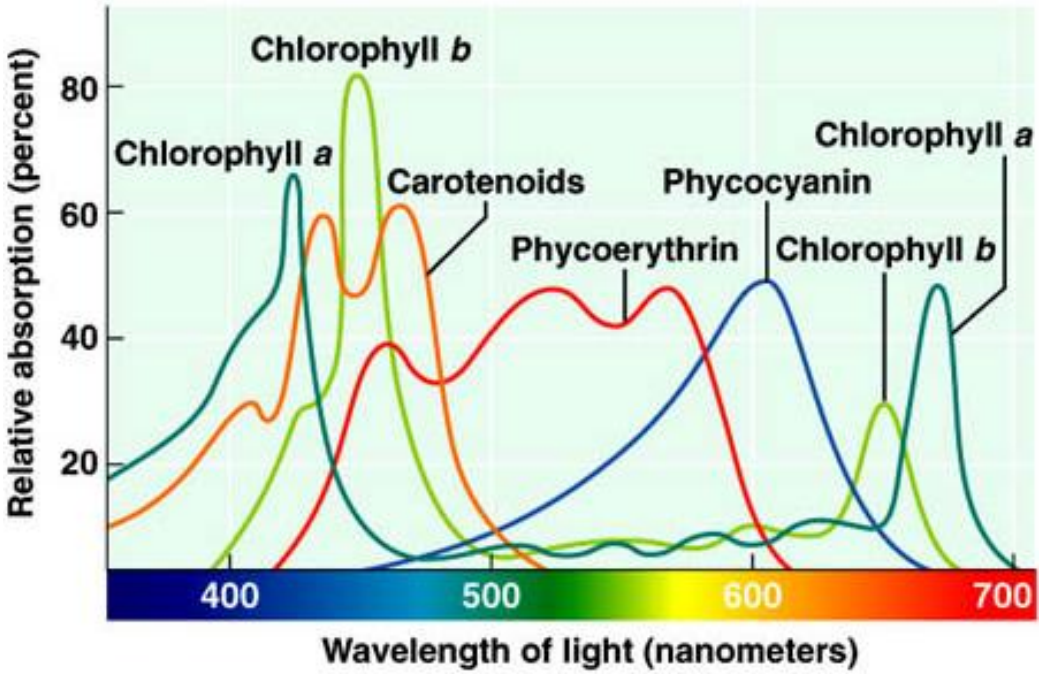
Μοριακές δονήσεις προσδετών & Δομή

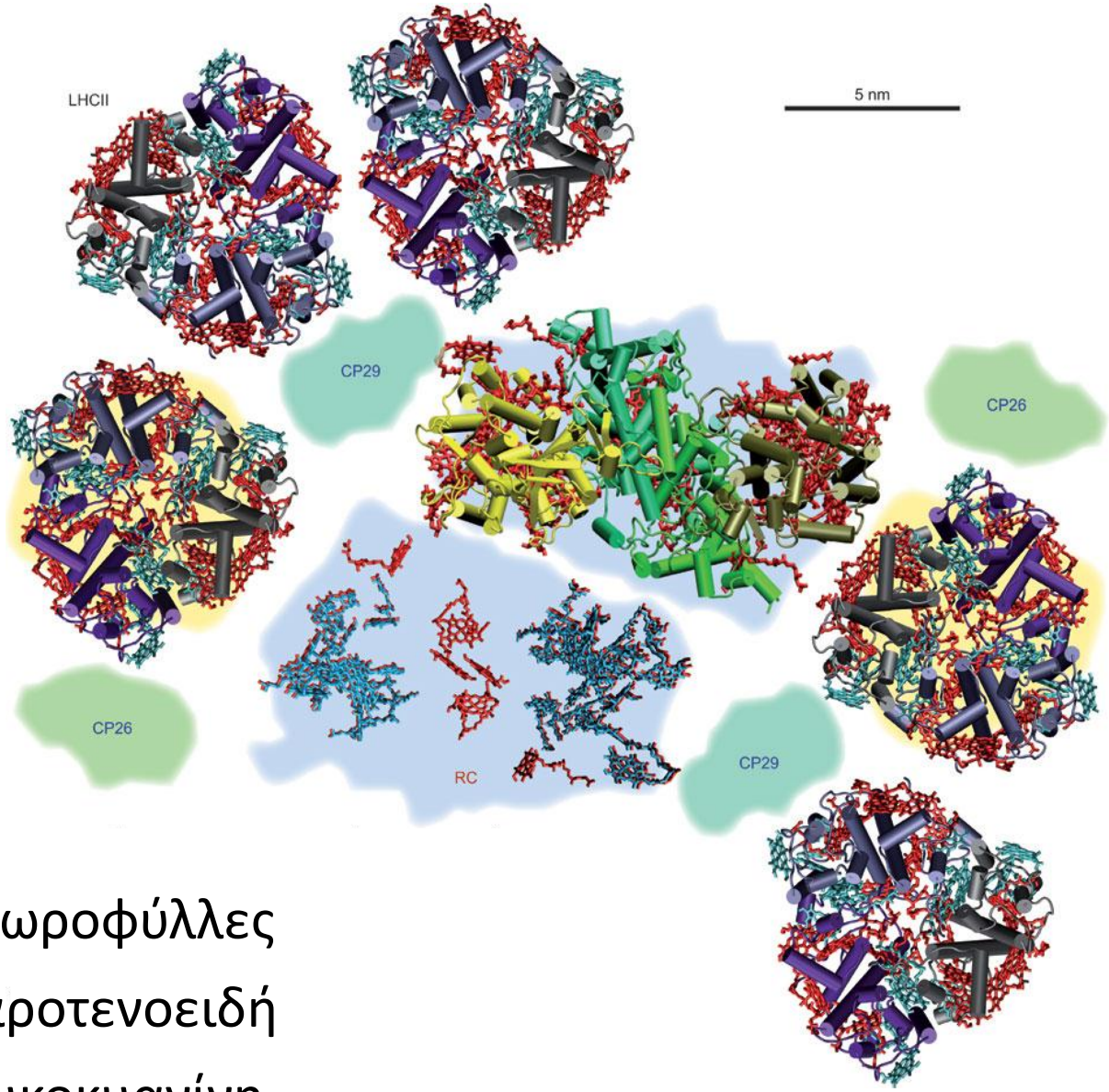
Turin L., *Chem. Senses*, **1996**, 21, 773-791

Φωτοσύνθεση

$$CO_2 + H_2O + \boldsymbol{h\nu} \rightarrow (CH_2O) + O_2$$

απόδοση >95%

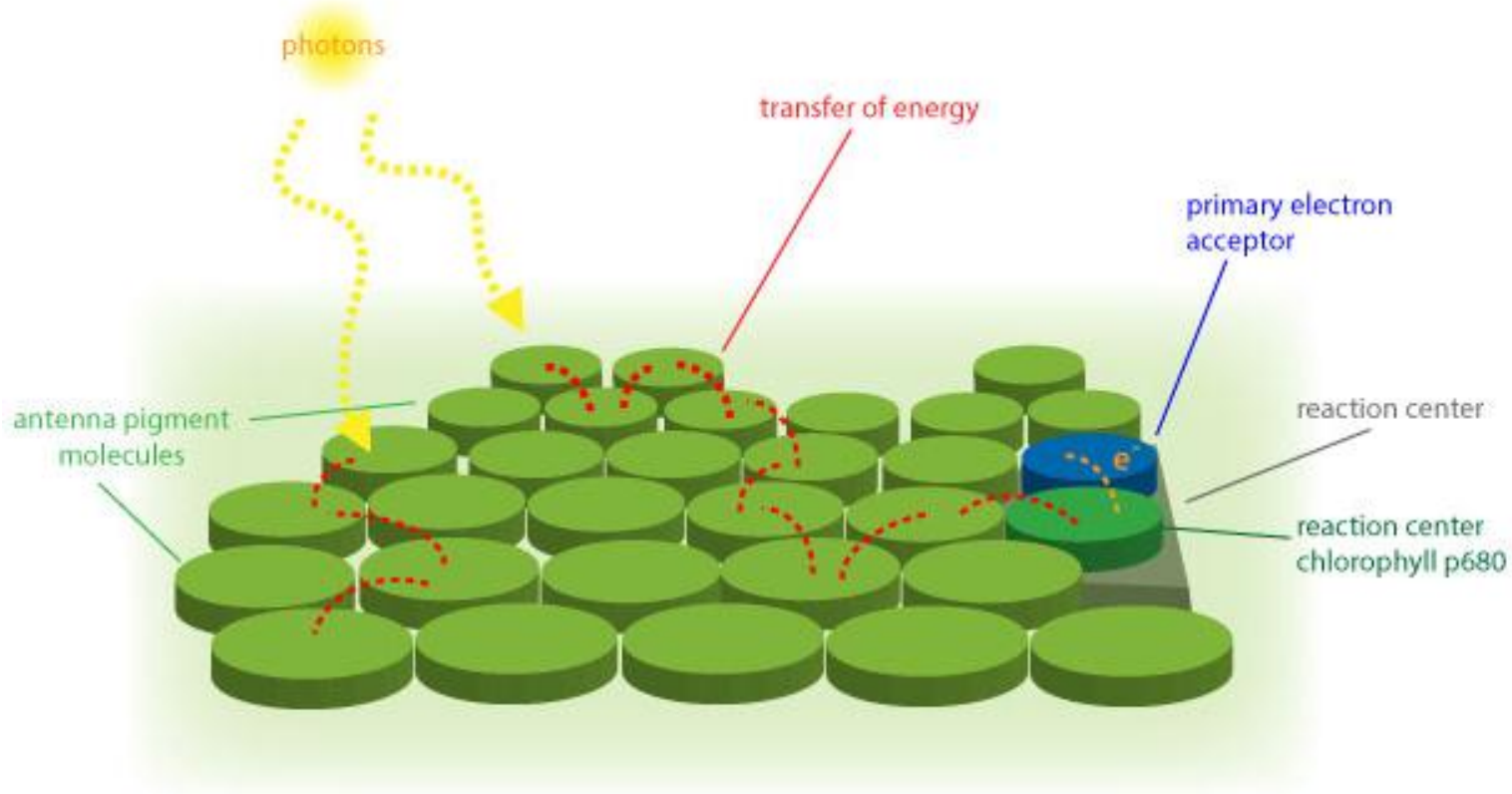




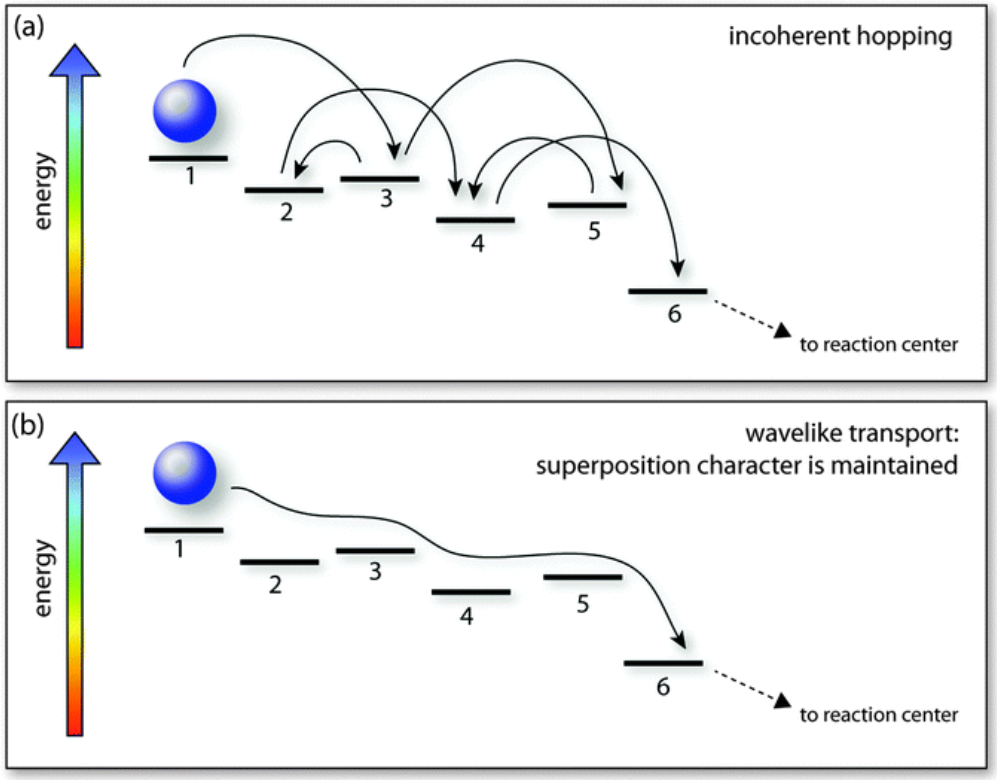
- Χλωροφύλλες
- Καροτενοειδή
- Φυκοκυανίνη
- Φυκοερυθρίνη

Grondelle R. et al, *Nature Chem.*, **2011**, 3, 763-774

Φωτοσύνθεση



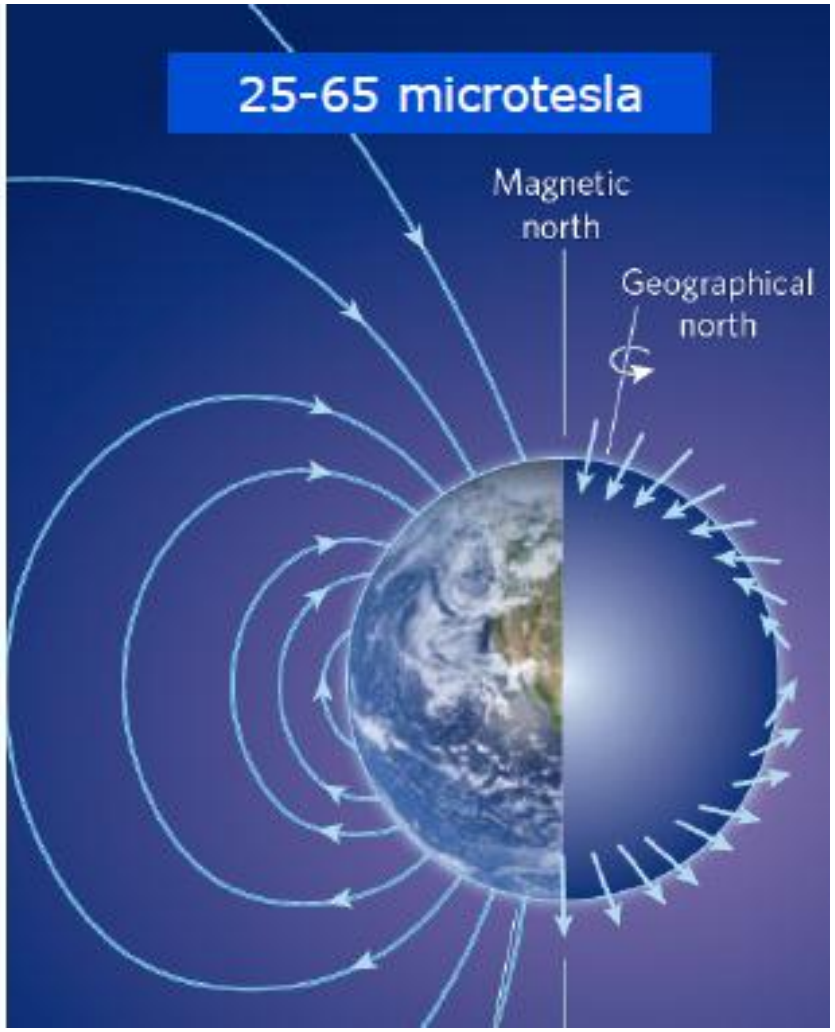
Lents N.H., *Visionlearning Vol. BIO-3*, **2014**, 6



Collini E. et al, *Chem. Soc. Rev.*, **2013**, 38, 185-196

«κβαντική συνεκτική μεταβίβαση ενέργειας»

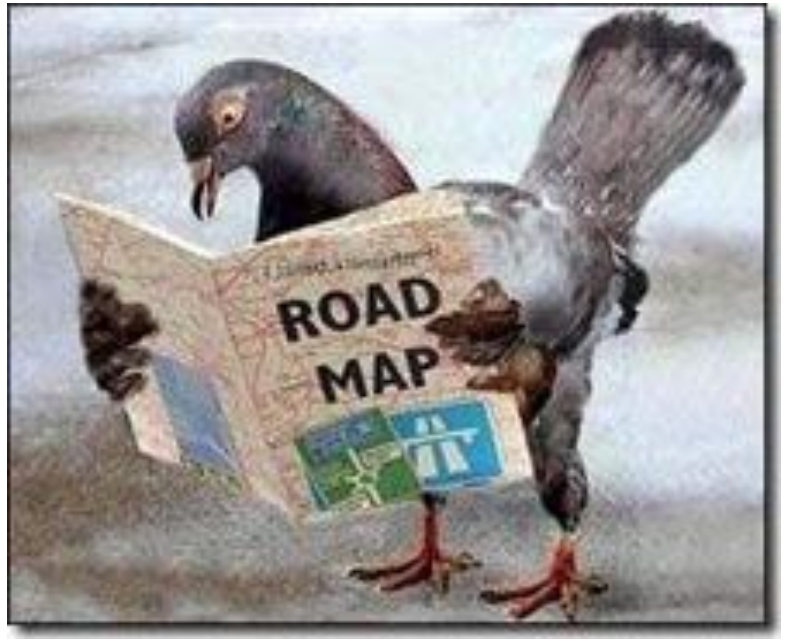
Η χημική «πυξίδα»



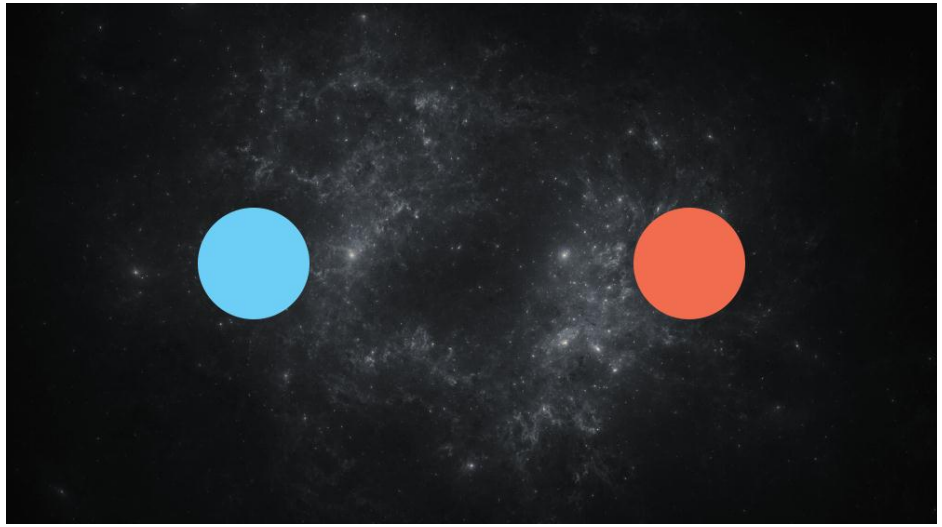
Finlay C. C. et al, *Geophysical Journal International.*, **2010**, 183, 1216-1230

Η χημική «πυξίδα»

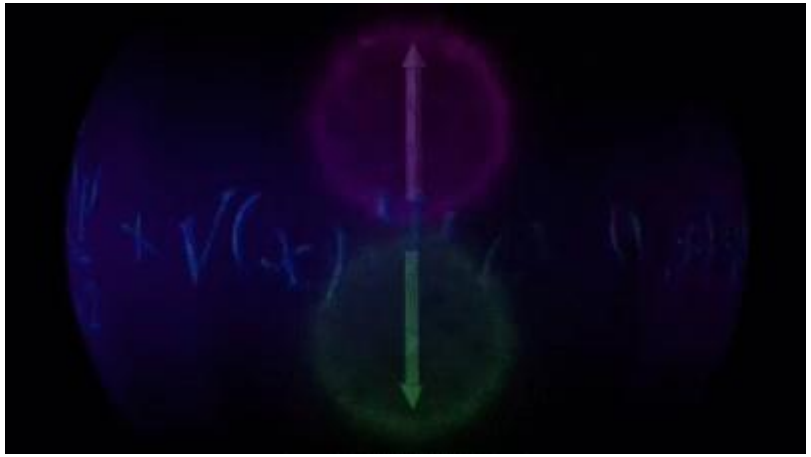
$$[\frac{-\hbar^2}{2m}\nabla^2 + V]\Psi = i\hbar\frac{\partial}{\partial t}\Psi$$



Κβαντική «Διεμπλοκή»



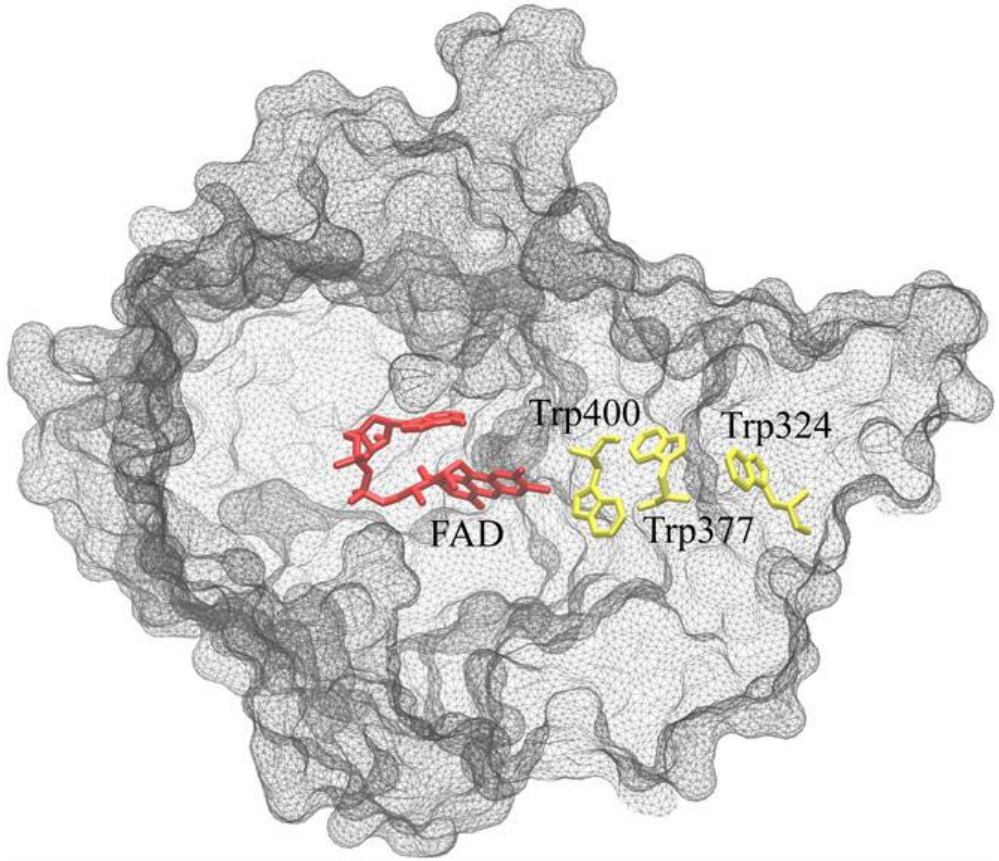
μια μορφή «επικοινωνίας» & «μνήμης» μεταξύ σωματιδίων σε απόσταση

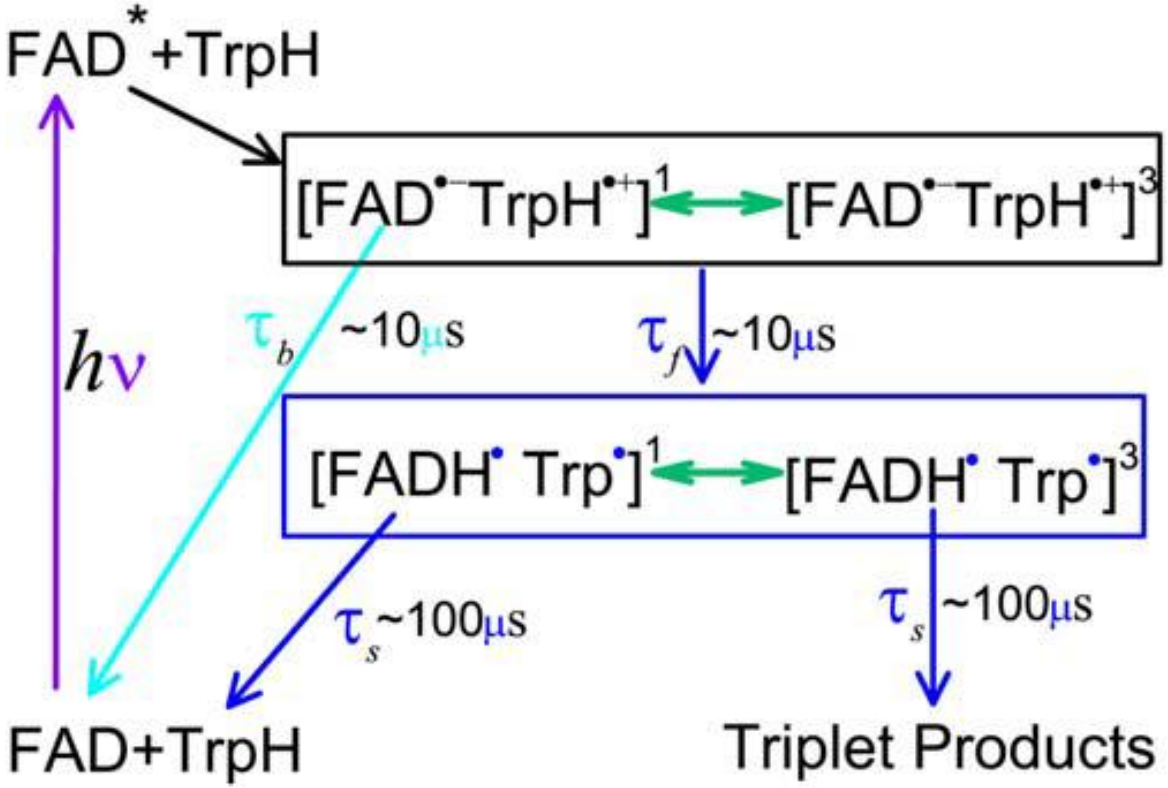


1935: Einstein

“spooky action at a distance”

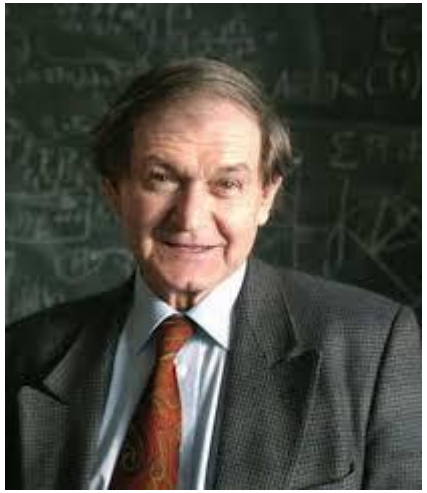
Η «πυξίδα» του E. κοκκινολαίμη

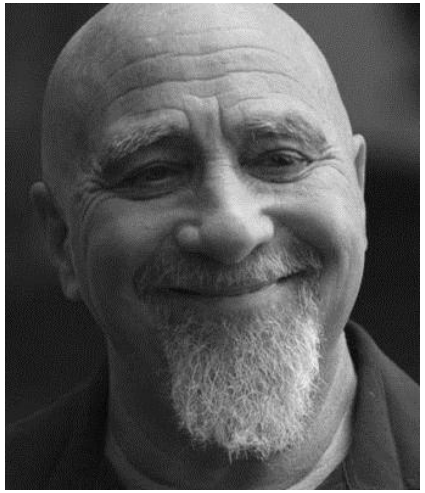




Schulten K. et al, *Biophysical Journal*, **2007**, 92, 2711-2726

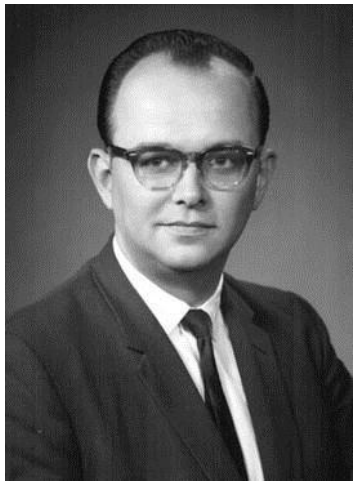
Kais S. et al, *International Journal of Quantum Chemistry*, **2015**, 115, 1327-1341





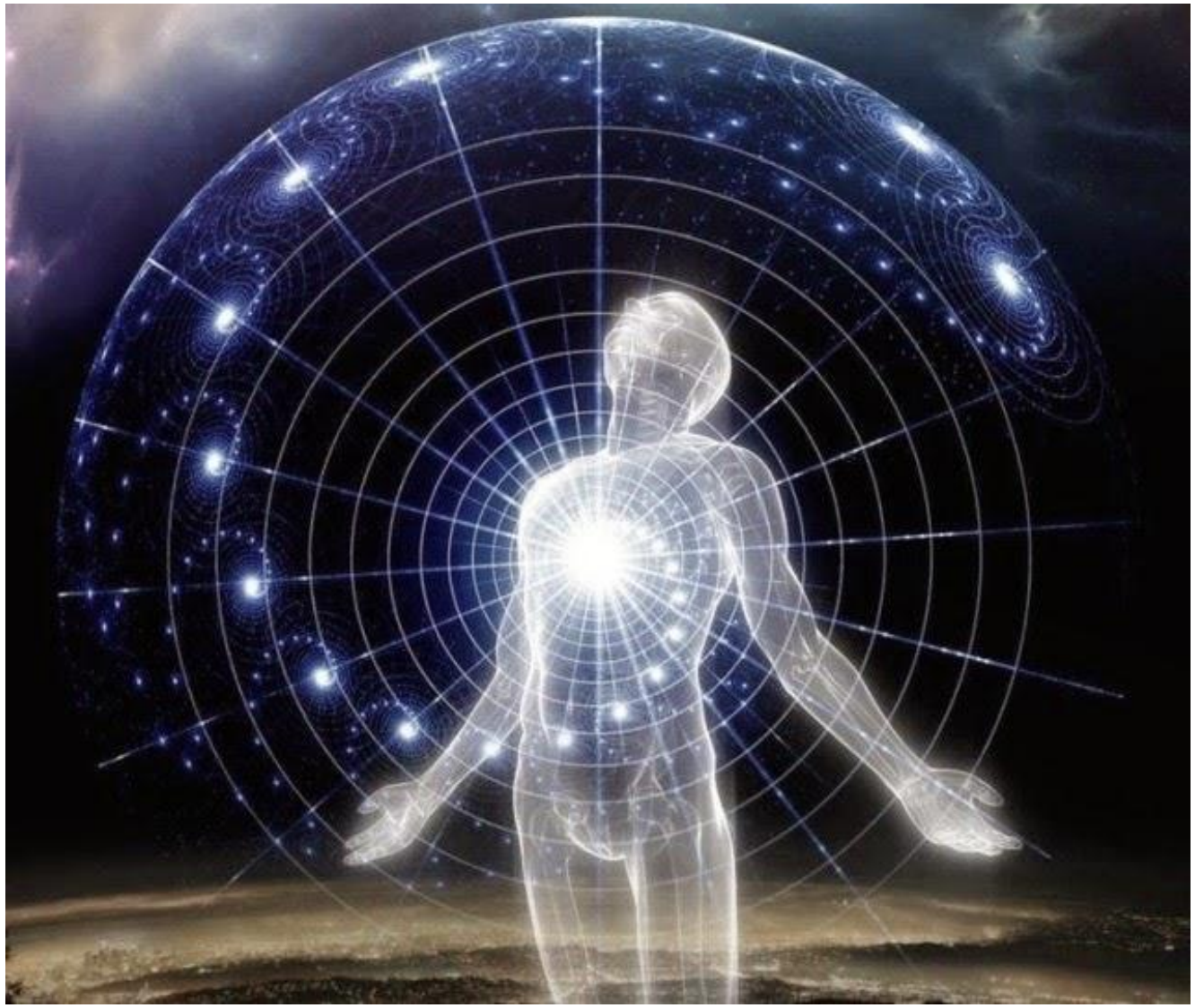
Hameroff-Penrose:

"Quantum coherence in brain microtubules"



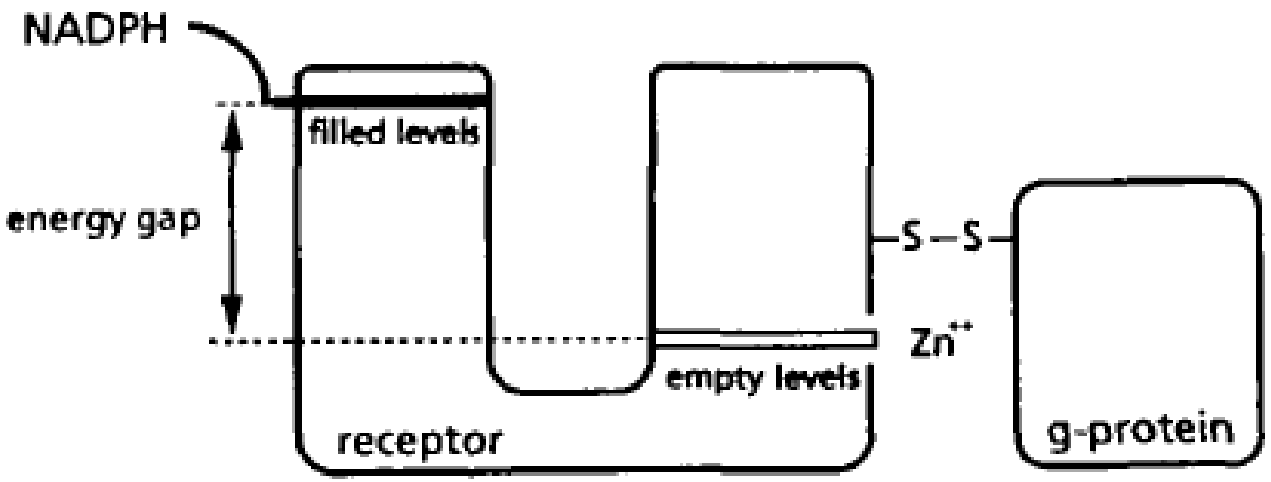
Everett's

"many worlds"



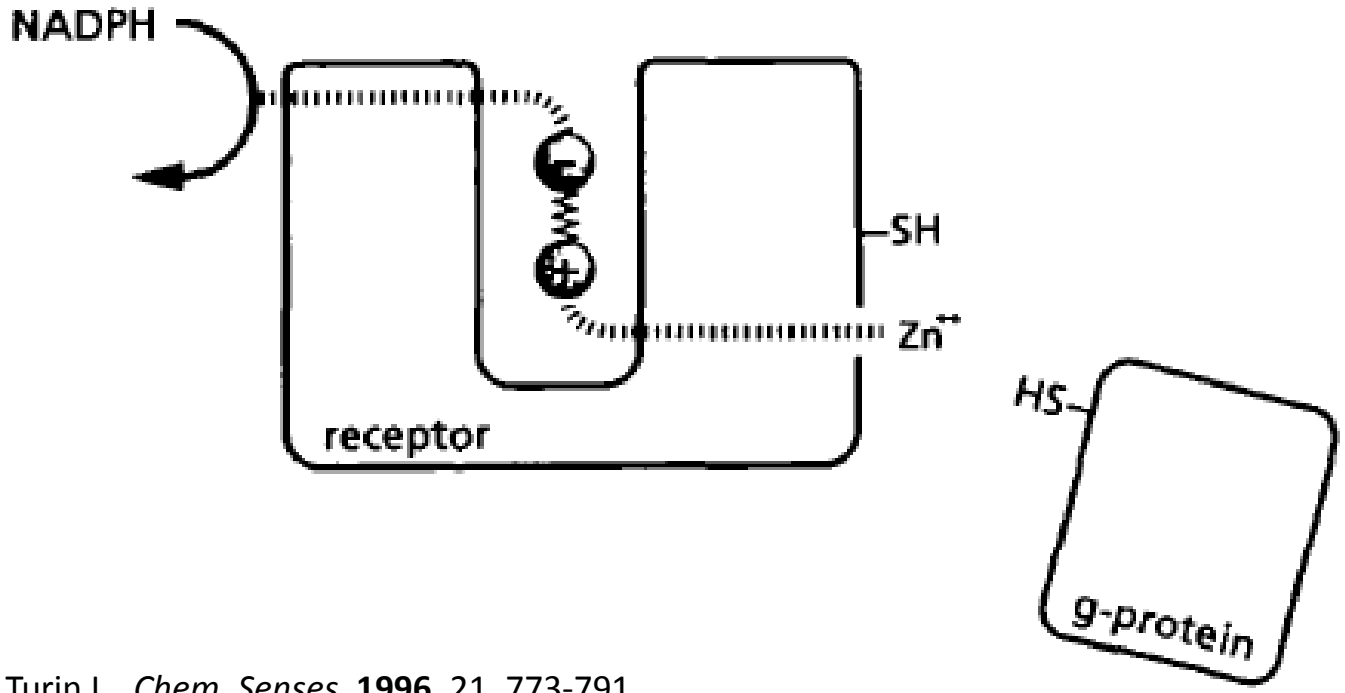
Hameroff S., *Phil. Trans. R. Soc. Lond. A*, **1998**, 356

Ευχαριστώ για την προσοχή σας!



Προτεινόμενος Μηχανισμός

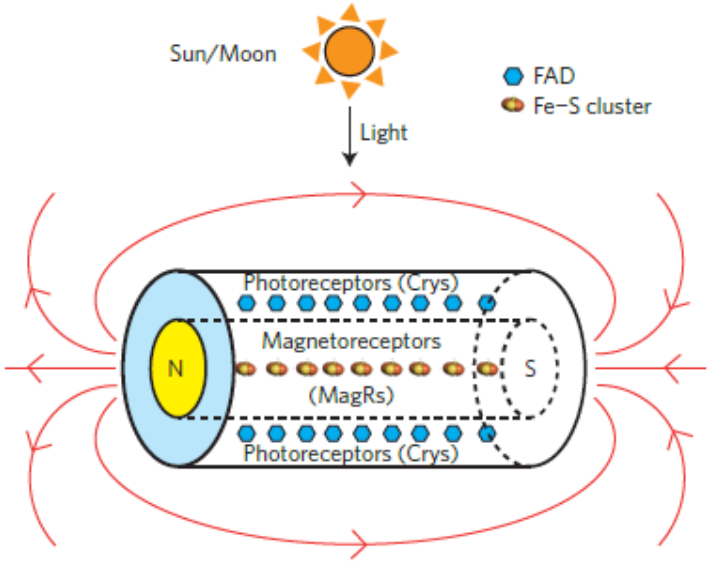
Turin, 1996

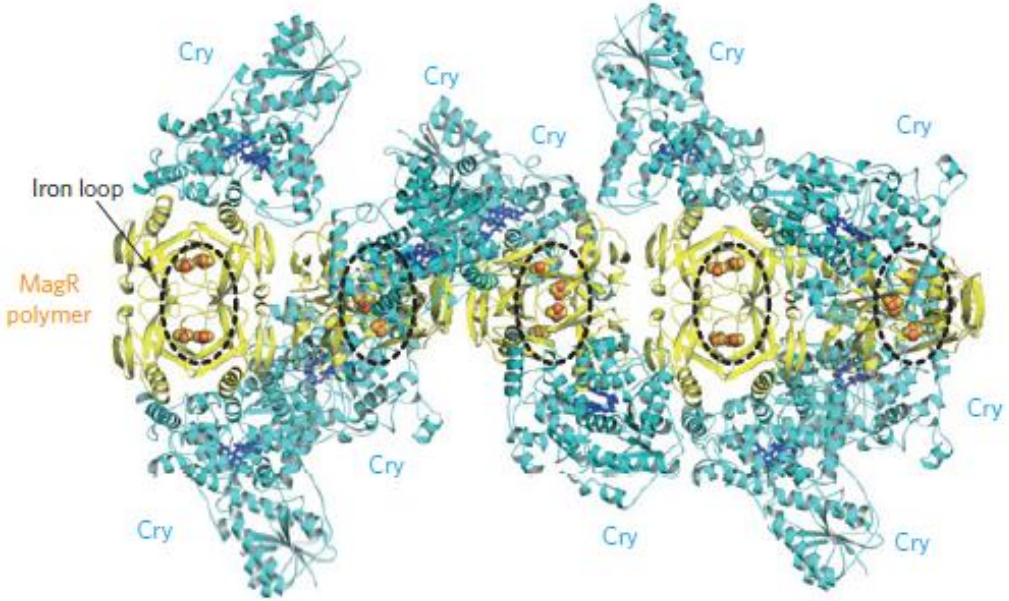


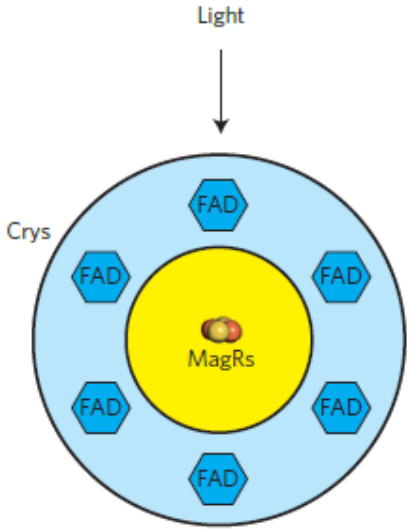
Μοριακές δονήσεις προσδετών
&
Δομή

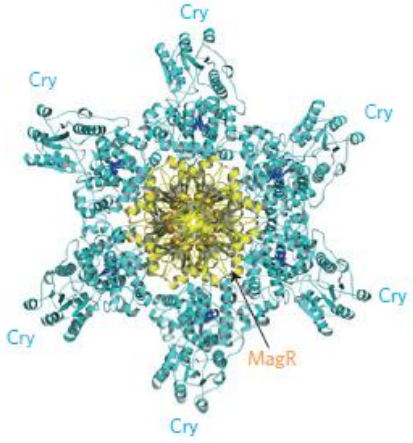
Turin L., *Chem. Senses*, **1996**, 21, 773-791

Η «πυξίδα» του E. κοκκινολαίμη









Qin S. et al, *Nature Materials*, **2016**, 15, 217-226