instituto de telecomunicações

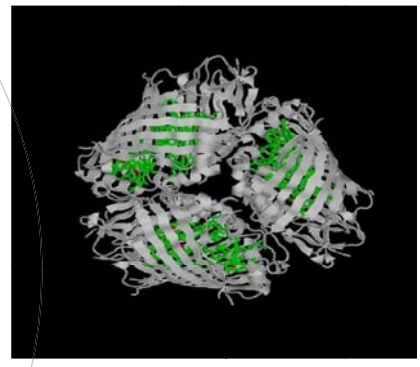
FCT Fundação para a Ciência e a Tecnologia
MINISTÉRIO DA EDUCAÇÃO E CIÊNCIA
PEst-OE/EEI/LA0008/2011
PEst-OE/EEI/LA0008/2013

Energy transfer efficiency in the quantum regime

Background and challenges

Quantum effects found in photosynthesis

Quantum ("wavelike") behavior found in natural light-harvesting complexes. (2007)



These complexes have **very high energy transfer efficiency (99%)!** (transferring solar energy to be used in chemical reactions in the plant)

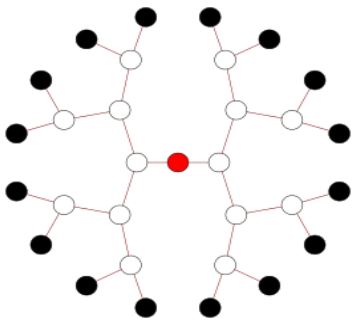
Models are being developed and studied to understand **how such high efficiencies are achieved**.

Questions: Can we **mimic such behavior** in artificial light-harvesting systems? Does quantum mechanics play a role in achieving such high efficiencies?

Description of the work

Quantum transport in binary trees

How efficient is a binary tree structure as a light harvesting system?



Studied energy transfer efficiency as function of several parameters of the model: **losses, imperfections, interaction with surroundings.**

Achievements

- Found regime of parameters which **maximizes** energy transfer efficiency.

- Interaction with surroundings and imperfections actually **improve efficiency** of quantum transport.

- This understanding is important for **design of artificial light harvesting systems** which can lead to **more efficient solar cells**.

The Physics of Information group acknowledges funding from:

- **EU FP7** projects **LANDAUER** (GA 318287) and **PAPETS** (GA 323901).
- **FCT Doctoral Programme** in the Physics and Mathematics of Information (DP-PMI).
- **Project QuSim** – Integrated Photonics Quantum Simulations, IT (03/2014 – 02/2016).
- **Project CQVibes** – Classical and Quantum Vibrations in Biomolecules, partially funded by EU FEDER.

FCT Scholarship SFRH/BD/52241/2013