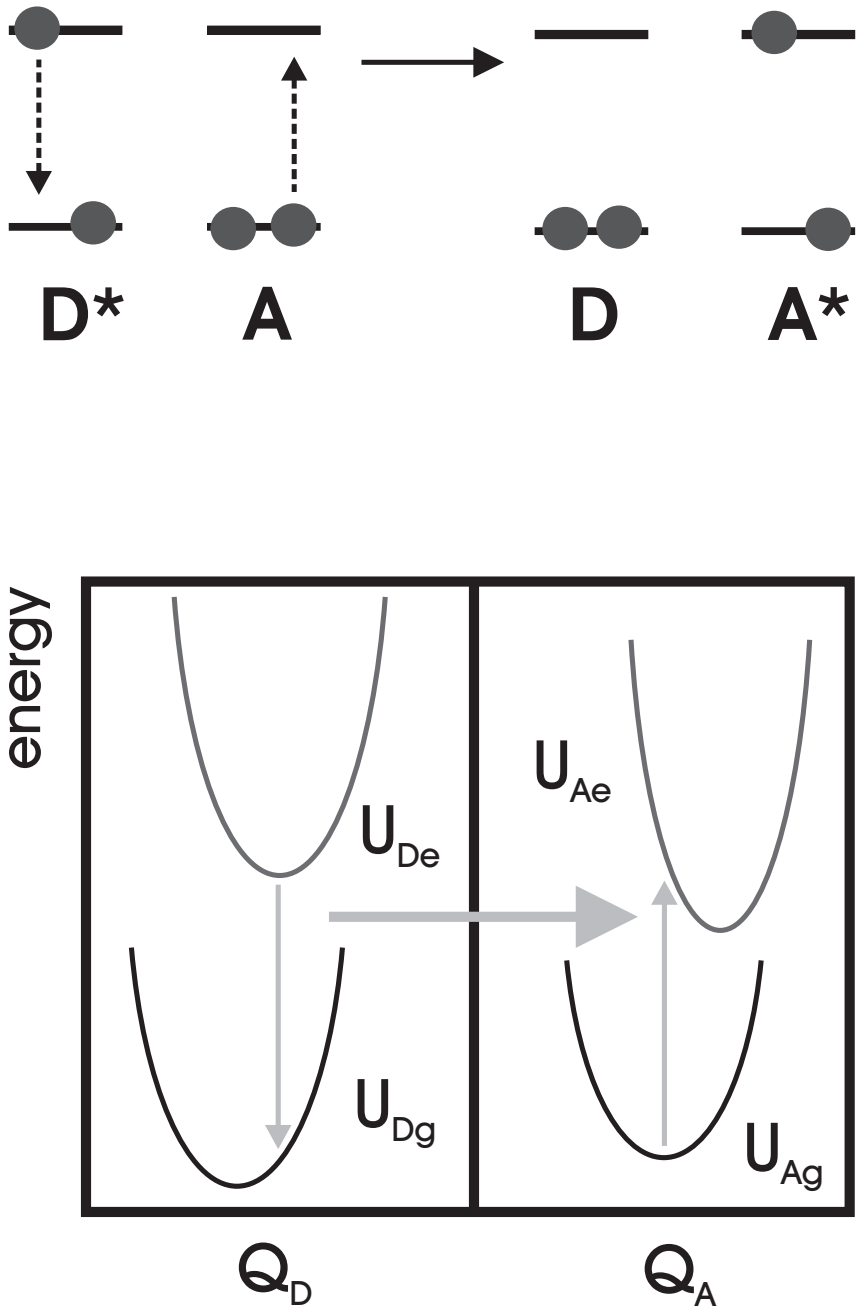


Figure 3.1: Excitation energy transfer between an energy donor molecule D and an acceptor molecule A: upper panel HOMO LUMO scheme, lower panel: scheme of potential energy surfaces. D is initially in the excited state in which one electron has been promoted from the HOMO to the LUMO. In the final state D is in its ground state and A is excited. The Coulomb interaction J triggers the exchange of excitation energy. (If the excited donor is in the singlet spin state the electron spin of the LUMO electron may be upwards and that of the HOMO electron downwards as well as vice versa. Such a spin configuration is also reached for the excited acceptor after excitation energy transfer.)

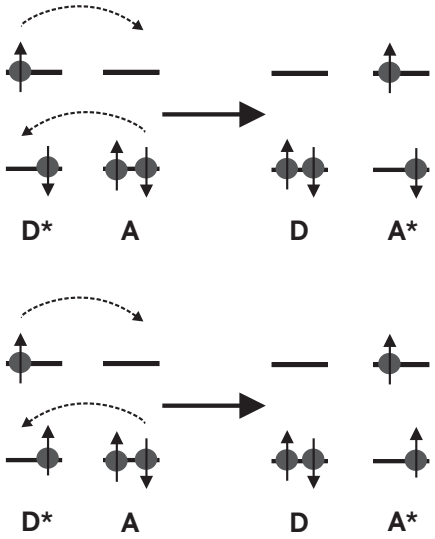


Figure 3.2: Excitation energy transfer between an energy donor molecule D and an acceptor molecule A viewed as a two electron exchange process. Both molecules are described in a HOMO–LUMO scheme. Upper panel: singlet singlet transfer (inverse spin orientation in D^* and A^* is also possible), lower panel: triplet triplet transfer (inverse spin orientation in D^* and A^* is also possible).

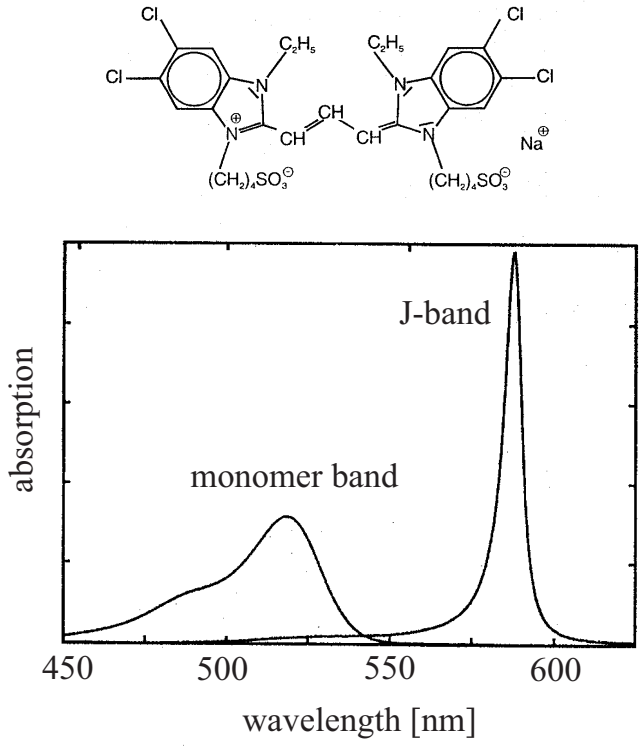


Figure 3.3: Molecular structure of the dye TDBC (5,5',6,6'–tetrachloro–1,1'–diethyl–3,3'–di(4–sulfobutyl)– benzimidazolcarbocyanine) forming J–aggregates, together with the room temperature monomer absorption (in methanol) and the J–band (in water).

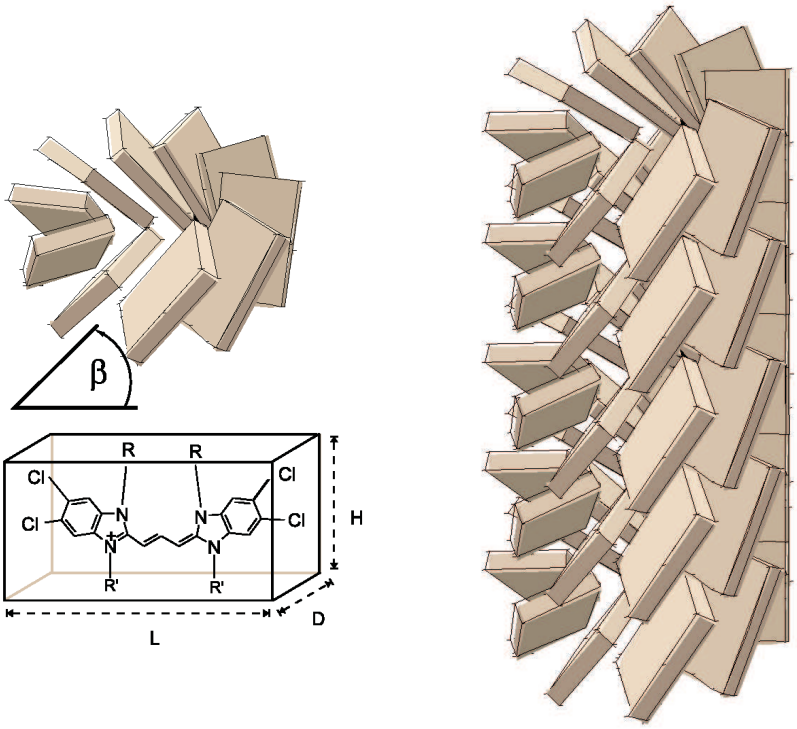


Figure 3.4: Cylindrical J–aggregate of an amphiphilic dye. The basic structure is shown in the lower–left part in a box with L = 1.9 nm, D = 0.4 nm, and H = 1.0 nm. The transition dipole moment lies in the direction of the long edge. Upper–left part: single circle built by 10 molecules, right part: tenfold helix formed by five of the shown circles.

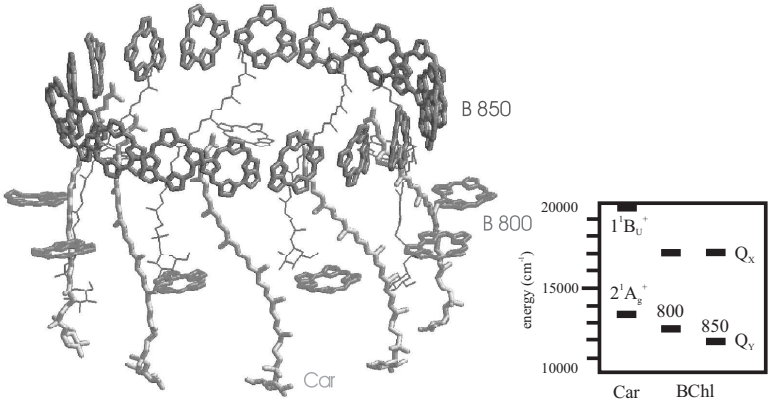


Figure 3.5: Schematic view of the so–called LH2 antenna which is typical for a number of photosynthetic bacteria (left panel). The active pigments are bacteriochlorophyll *a* molecules (BChl a), of which only the porphyrine planes are shown. These pigment molecules form two rings interconnected by carotenoids (Car) and stabilized by proteins (not shown). Since the two pigment rings differ by their absorption wavelength (800 nm and 850 nm) they are labelled as B800 and B850. Important excited electronic states of all pigments are displayed in the right panel. (LH2 figure courtesy of J. Herek)

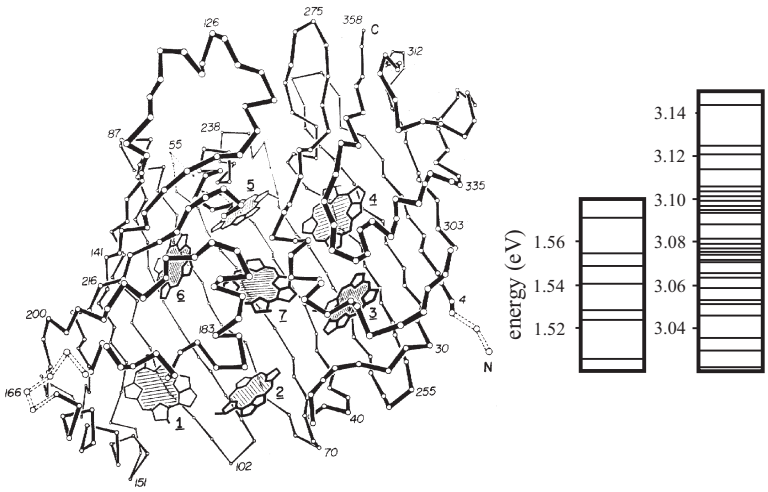


Figure 3.6: Schematic view on a single subunit of the Fenna–Mathew–Olsen complex (located in the base plate of the green sulphur bacterium *Prosthecochloris aestuarii*). Shown are the seven bacteriochlorophyll*a* molecules as well as the backbone of the carrier protein. The right panel displays the energetic position of the seven single–exciton levels (around 1.54 eV) and of the 21 two–exciton levels (around 3.8 eV, together with seven higher singlet excitations).

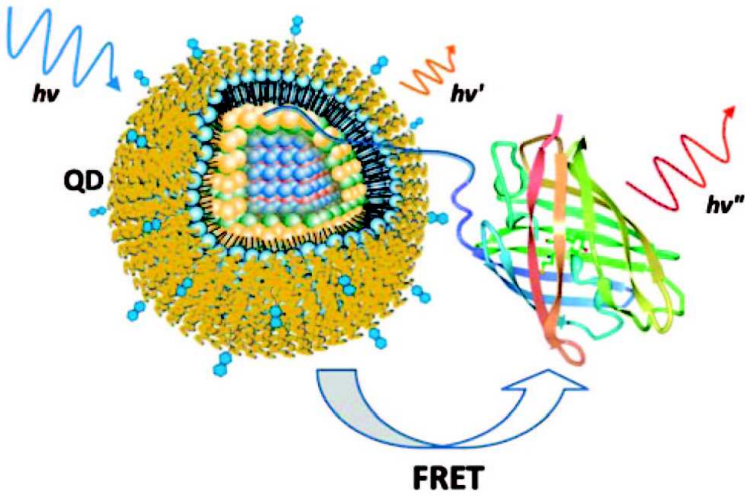


Figure 3.7: Fluorescence resonance energy transfer (FRET) between a CdSe/ZnS core–shell quantum dot (coated with a lipid layer) and a fluorescent protein (similar to the green fluorescent protein). Both are connected via a polyhistidine chain. Under excitation of the quantum dot, energy is nonradiatively transferred to the fluorescent protein and sensitized emission is observed (reprinted with permission from A. M. Dennis and G. Bao, NanoLetters 8, 1439 (2008); copyright 2008 American Chemical Society).

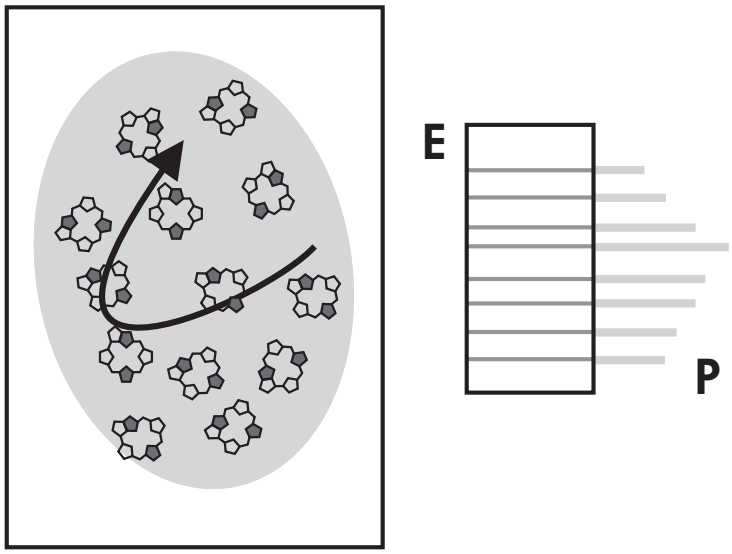


Figure 3.8: Schematic illustration of coherent exciton motion in a chromophore complex (of pheophorbide–a molecules, left panel). The shaded area symbolizes the exciton extending over several monomers. Coherent motion appears via wave packet formation $|\phi(t)\rangle = \sum_\alpha A_\alpha |\alpha\rangle$ within the energy spectrum of delocalized exciton states (right panel, the horizontal sticks indicate the proability P every exiton state is involved in the wave packet formation).

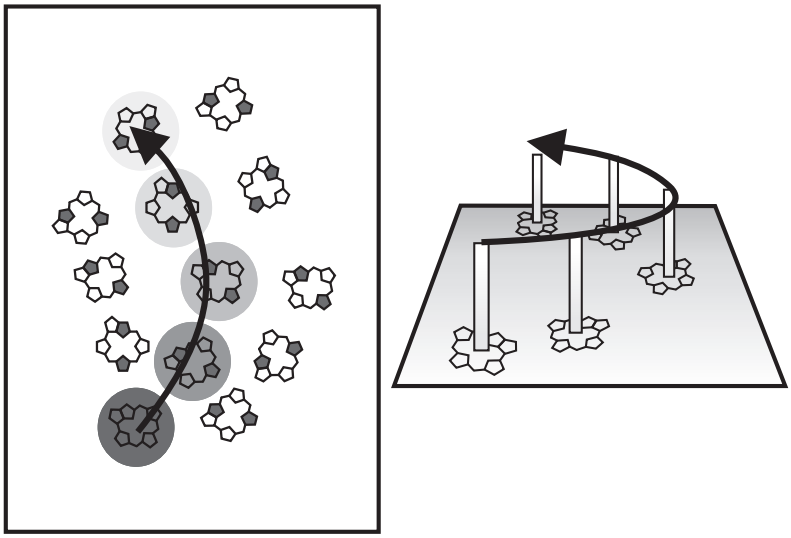


Figure 3.9: Schematic illustration of incoherent exciton motion in a chromophore complex (of pheophorbide–a molecules, left panel). The excitation hops from molecule to molecule (at a certain time the excitation is present at the different molecules with a certain probability corresponding to the grey scale). The right panel characterizes the molecules as an electronic two–level systems (upper and lower end of the vertical sticks) with the excitation of the upper level moving along a particular path (indicated by the arrow).

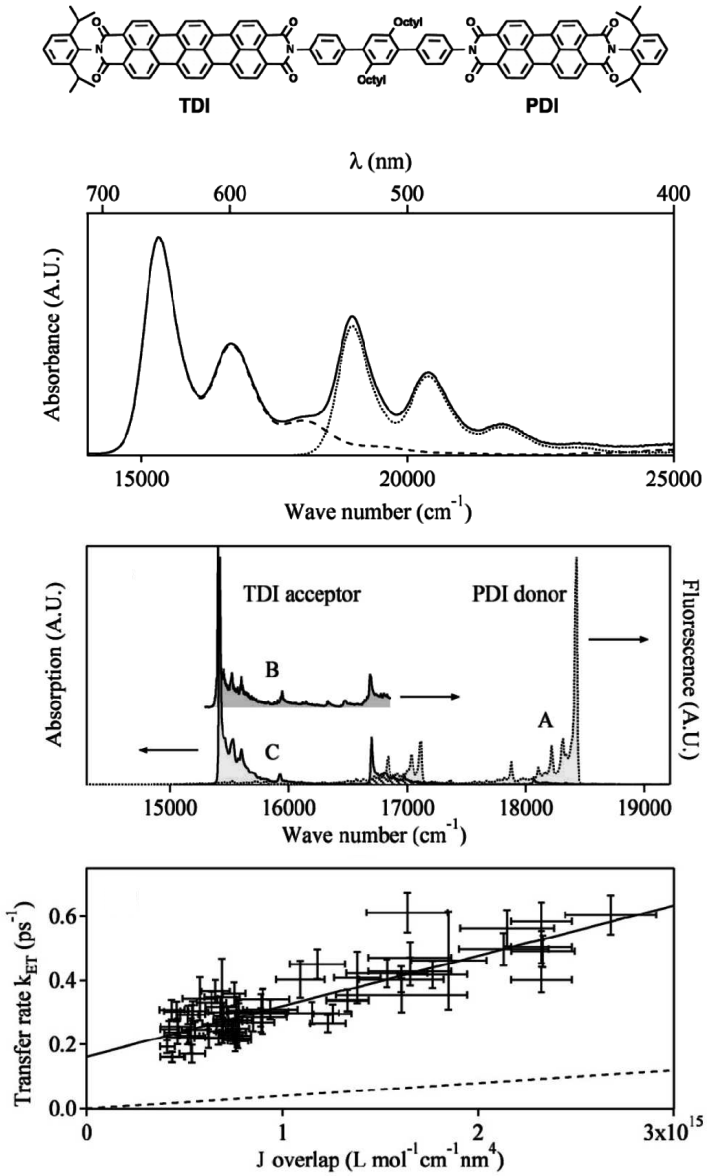
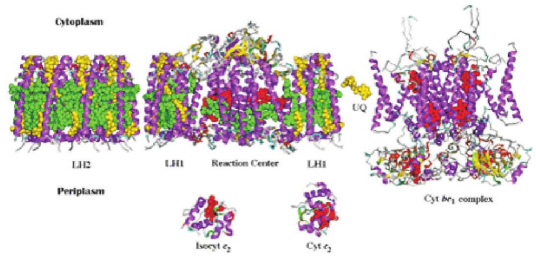
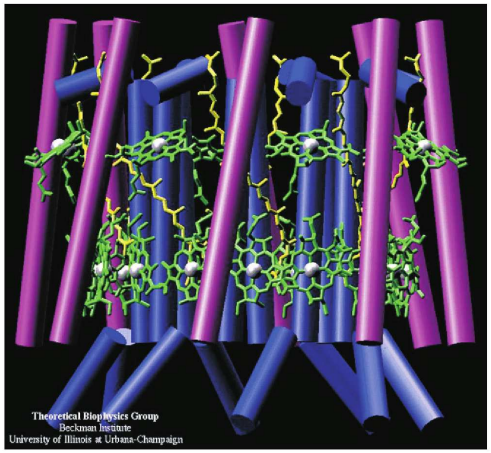
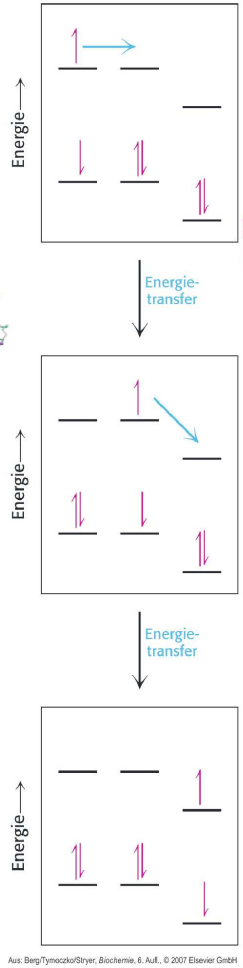


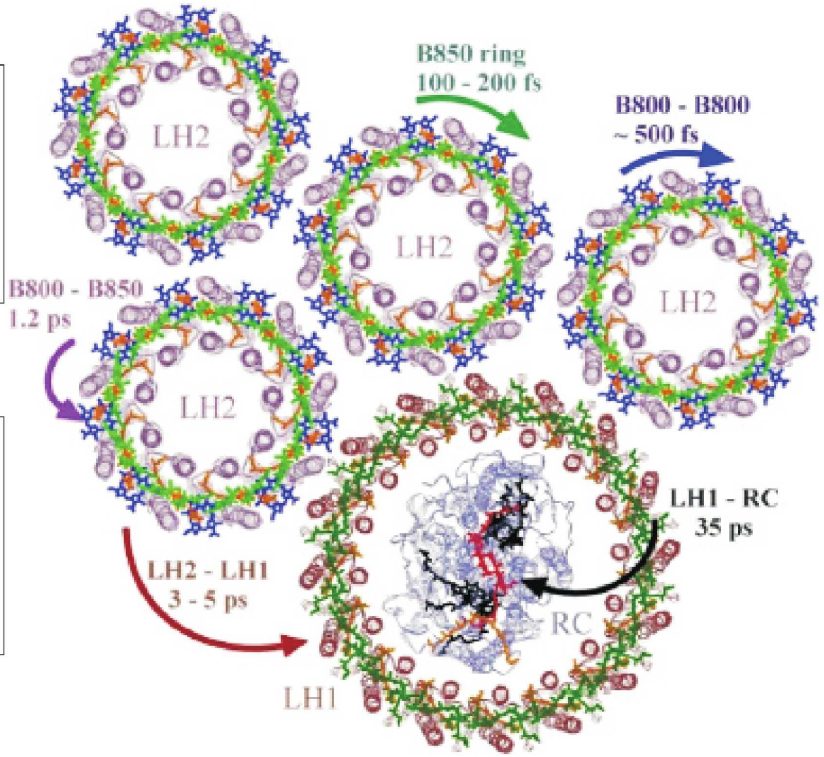
Figure 3.10: EET in a donor (PDI) acceptor (TDI) pair (chemical structure – upper scheme) characterized by single molecule spectroscopy. Second panel: room temperature absorption spectra (dotted curve: donor, dashed curve: acceptor), third panel: single donor fluorescence emission spectrum (A, 1.4 K), single acceptor fluorescence excitation spectrum (B, 20 K) with spectral overlap (C), fourth panel: experimentally determined EET rates versus spectral overlap (after R. Metivier, F. Nolde, K. Müllen, and Th. Basche, PRL 98, 047802 (2007)).

Energie- und Ladungstransport in der Photosynthese









Der Resonanzenergietransfer. Die von einem Molekül absorbierte Energie kann auf benachbarte Moleküle mit angeregten Zuständen gleicher oder niedrigerer Energie übertragen werden.

Figure 3.11: