Novel Dark States in Dimers due to Permanent Dipoles

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Abstract

Many organic molecules posses large permanent dipole moments that can change when they are excited. We have investigated the optical effects that these permanent dipoles can have when in a dimer system. By calculating the transition rate contribution of the different physical processes that can occur, we see how permanent dipoles effect the master equation in various regimes. We find that there are two distinct mechanisms by which dark states can form. The first arises from the destructive interference of the transition dipoles when in a superposition state of both monomers. In this case, permanent dipoles can cause the the dark state to leak and become optically accessible from both the ground and bright state, depending on their orientation. The second process for dark state formation is unique to permanent dipoles and arises from the destructively interference between the transition and permanent dipoles. This creates a localised dark state that is optically accessible from the bright state. Both mechanisms can be used to optimise energy transfer across the dimer.

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