Master or Bachelor Project - Strong light matter interaction to manipulate singlet fission in photovoltaic materials

When light is absorbed by an organic semiconductor, an electron hole pair (exciton) is created. Understanding and controlling these states is very important for optoelectronic applications. Some materials have the remarkable property that one excited (bright) singlet exciton can split into two (dark) triplet excitons. This process is called singlet fission. Singlet fission can enhance the efficiency of solar cells, by creating two energy carriers out of one photon. To achieve enhanced photovoltaic performance, it is important to have efficient singlet fission.

In this project we will investigate how the singlet fission rate can be influenced by strong light-matter interaction. When an excitonic material is put in an optical cavity with the electromagnetic mode tuned to the energy of an exciton, the two modes interact and influence each other. When the interaction is strong enough this leads to the formation of two new modes, called polaritons. These polaritons have partial photonic and excitonic character. This hybrid character can have a large influence on many properties of the excited states in the material, such as the effective mass, delocalization of the wave function and energy levels. As the coupling only affects the bright states and not the dark states, one can tune singlet energy with respect to the triplet energy. ***The goal of this project is to investigate how the tuning of these two levels may affect singlet fission.***

During this project you will do simulations on the properties of polaritons in a plasmonic array of nanoparticles defining an optical cavity. You will have to design and characterize systems that support exciton-polaritons and investigate the properties of the hybrid material using advanced nanophotonic techniques.

If you’re interested or would like to have more information, please contact:

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