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Towards Inorganic Photosynthesis

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Title: Towards inorganic photosynthesis

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Project Summary

Photosynthesis is the primary method for transport of energy in nature. The most exciting feature of such a process is its efficiency, which occurs with nearly %100 efficiency. Recent research have shown the underlying mechanism behind such a fascinating light harvesting process is related to quantum mechanics. Using inorganic materials such semiconductor quantum dots and metallic nanostructures, the goal of this project is to examine some basic processes that can imitate photosynthesis. This will be done at the Nanophotonics and Quantum Devices Lab (NQDL) in the department of Physics and Astronomy at UAH. This lab has significant experience in regard to fabrication and spectroscopy of nanostructures and measuring the rate of energy transfer between different nanostructures. NQDL has also state-of-art systems for imaging and single photon counting. This project provides undergraduate students the opportunity to study how photosynthesis works in nature, review previous reports that imitate this process in laboratory using inorganic materials, and carry out some measurements in regard to energy transfer between nanostructures.

For this RCEU project the student and I will work together to set up an optical system in my one of my labs. We will study optics of semiconductor quantum dots, including their emission intensity and decay. The outcomes will be used to extract the rate that energy hops from one nanoparticle to another. The undergraduate student needs to learn spectroscopy as tool. No major optical set up is needed. He/she will have the chance to use this technique for imaging applications, if time allows.

Student Prerequisites

Minimum GPA: 3.5
Completed second year of college by summer of 2020
Passed some laboratory courses (physics, chemistry, or biology)

Student Duties

The student will be expected to:

1. Carry out spectroscopy of semiconductor quantum dots
2. Measure energy transfer rate between different types of quantum dots
3. Set up some limited optics
4. Analyze the date
5. Document the data and report

The process of setting up the experiments will expose the undergraduate student to important optical equipment including lasers, monochrometers, spectrometers, ultrahigh sensitive

photodetectors, etc. He/she will also be exposed to frontier of research in plasmonics and optics. The student will be expected to create report on weekly basis summarizing the major findings of his/her research and to present his/her findings at the end of the summer. The data collected must be saved properly in the Nanophotonic Lab.

Mentor Supervision and Interaction

I will have a fairly direct interaction with the student, with daily meetings discussing goals for the day followed by various progress checks throughout the day. The project will rely on regular collaboration to troubleshoot experimental issues as well as to discuss the results of the experiments and their implications, which will constitute the educational portion of the program. The interested undergraduate student will also be collaborating with my graduate students working on related experiments.