



## International Doctoral Program in Science Position

### Achieving quantum coherence in organic solar cells

#### Background and motivation

Access to and control of the quantum-coherence of a system is emerging as a promising strategy for the realization of devices with disruptive properties and unprecedented efficiency. For instance, quantum coherence, in organic photovoltaics, could play a crucial role at each step of the photoconversion process. At the excitation stage (1), coherence (superposition) of excitonic states is proposed to amplify processes of multiexciton generation. During the exciton transport (2), energy losses can be minimized if the exciton diffuses on a distance comparable with its coherence (delocalization) length. Finally, if the charge collection (3) occurs on timescales faster than the electronic decoherence, the charge thermalization is ideally circumvented and the conversion efficiency maximized.

Recently, coherent two-dimensional (2D) optical spectroscopy has been proposed for the measuring of the coherent and dephasing times. However, the interpretation of the spectra typically relies on theoretical modeling that can be highly nontrivial for complex systems. One more versatile solution is offered by interferometric time-resolved multi-photon photoelectron spectroscopy (inter-tr-mPPE). The technique exploits two phase-locked, delayed laser pulses generated in a Mach Zehnder interferometer to record one photoemission spectrum per time delay between two phase-coherent pulses.

The aim of the present project is the realization of an inter-tr-2PPE setup to directly address coherences of an optical excitation and its dephasing in the time and energy domain. To achieve this, we are looking for a highly motivated student to implement the tr-2PPE spectroscopy facility available at the Elphos lab of the Department of Mathematics and Physics (Università Cattolica del Sacro Cuore) with a fully collinear interferometric scheme designed for inter-tr-mPPE experiments. This spectroscopy will be applied, for the first time, to organic systems, based on carbon nanostructures, grown and characterized in KU Leuven laboratories, combined with acene organic molecules where coherence is expected to act both at the excitation time and during the excitation transport on experimentally accessible and technologically promising timescales.

#### Profile

- Master's degree or similar qualification in Physics, Materials Science, Chemistry or adjacent fields. The title must be obtained by October 31<sup>st</sup>, 2020.
- A solid background in physics, materials science or materials chemistry is required.
- Experience with femtosecond laser systems and in time resolved spectroscopies (pump-probe set up), and in home-built instrumentation will be considered as an advantage.
- Good knowledge of the English language, both spoken and written, is essential.
- Strong commitment, ability to work in a team, and eager for international mobility is desired.

#### Opportunities

- Experimental research participating to the international collaboration between research groups KU Leuven and Italy. **Double degree opportunity.**

#### Contacts

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