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HORIZON EUROPE
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SpinSC - Spin-mediated spectral conversion for efficient photovoltaics

Improving the efficiency of photovoltaics (PV) is essential to accelerate the pursuit of carbon neutrality. As commercially available solar cells approach the 26% practical efficiency ceiling, we urgently need to find new ways to improve PV performance. A solution is to broaden the part of the incident solar spectrum that solar cells can absorb efficiently. The process of spectral conversion achieves this strategy by upconverting and downconverting the light wavelengths that are otherwise lost to transmission and heat. The spectral conversion processes that are key for photovoltaics are mediated by the spin of excited electronic states, whose short lifetime poses a challenge to their experimental investigation. However, the achievement of efficient spectral conversion depends on our ability to understand and control the complex quantum dynamics involved in these processes, which requires advanced theoretical and experimental methods. I have specialised in quantum system dynamics throughout my research career, becoming an expert in using analytical and numerical methods for their simulation. For my postdoctoral studies, I have undertaken an interdisciplinary path to apply my expertise to problems that I believe in having the highest urgency. I have worked on energy transport in molecular material for photovoltaics and collaborated with innovators in spectral conversion. With the same intentions, my objective is to determine the conditions for spectral conversion to occur efficiently in molecular materials.

At the University of Padua, I will learn fundamental skills necessary for this research, receiving crucial training for optimising and controlling spin-mediated spectral conversion. There, I will work with Prof. Simone Montangero, who has pioneered methods for the simulation and control of complex quantum systems. The successful outcome of this research will guide the fabrication of spectral converters, essential for enhancing photovoltaic performance.

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