O 1: Invited Talk (Xiaoyang Zhu)

Time: Monday 9:30–10:15 Location: H36

Invited Talk O 1.1 Mon 9:30 H36

Exciton fission, quantum coherence, & solar energy conversion beyond the limit — •Xiaoyang Zhu — Columbia University, USA

The maximum solar-to-electric power conversion efficiency of a conventional solar cell is determined by the Shockley-Queisser limit of ~31% [1]. A major reason for energy loss is because the absorption of photons with energy exceeding the bandgap creates hot electrons and holes with excess kinetic energy, which is quickly lost before the electrons and holes are captured. In this lecture, I will discuss a viable approach to exceed the Shockley-Queisser limit. This approach is based on the creation of two electron-hole pairs from the absorption of one photon in a process called singlet fission. I will illustrate how singlet exciton fission can occur in organic semiconductors due to a many electron quantum coherent process, and how to efficiently extract two electrons from the quantum coherent state [2-4]. These discoveries take us one step closer to designing solar cells with power conversion efficiency potentially exceeding the Shockley-Queisser limit.

[1] W. Shockley, H. J. Queisser, J. Appl. Phys. 32 (1961) 510-519.

[2] W.-L. Chan, M. Ligges, A. Jailaubekov, L. Kaake, L. Miaja-Avila, X.-Y. Zhu, Science 334 (2011) 1541.

[3] W.-L. Chan, M. Ligges, X.-Y. Zhu, Nature Chem. 4 (2012) 840-845.

[4] W.-L. Chan, J. R. Tritsch, X.-Y. Zhu, J. Am. Chem. Soc. 134 (2012) 18295-18302.