Magnetic field enhancement of organic photovoltaic cells performance

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Charge separation is a critical process for achieving high efficiencies in organic photovoltaic cells. The initial tightly bound excitonic electron-hole pair has to dissociate fast enough in order to avoid photocurrent generation –and thus power conversion efficiency– loss via geminate recombination. Such process is currently thought to take place assisted by transitional states that lie between the initial exciton and the free charge state [2]. As a consequence of spin conservation rules, these intermediate charge transfer states typically have singlet character. Here we propose a donor-acceptor model for a generic organic photovoltaic cell in which the process of charge separation is modulated by a magnetic field which tunes the energy levels. The impact of a magnetic field is to intensify the generation of charge transfer states with triplet character via inter-system crossing. As the ground state of the system has singlet character, triplet states are recombination-protected, thus leading to a higher probability of successful charge separation[3]. Using the open quantum systems formalism we demonstrate that not only the population of triplet charge transfer states grows in the presence of a magnetic field, but also how the power outcome of an organic photovoltaic cell is in that way increased.

[1] S. Oviedo-Casado et al. ArXiv e-print, 1702.05130 (2017).

[2] S. Gélinas et al. Science **343**, 512 (2014).

[3] A. Rao et al. Nature **500**, 435 (2013).