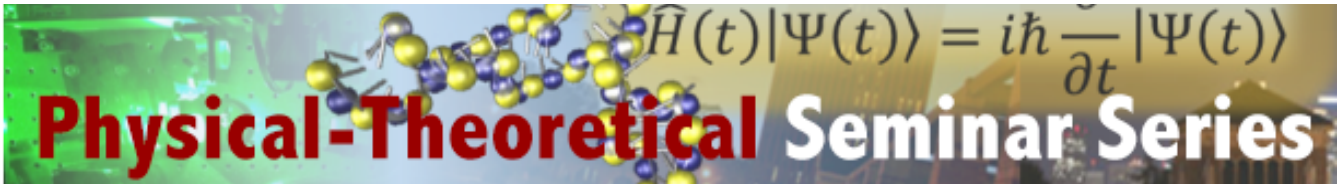

Monday, January 23, 2017, 12:00 pm in Seaver Science Library, Room 150

SSL next to the library

Dr. Timothy Schmidt

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University of New South Wales, Sydney

Triplet Fusion and Singlet Fission: Prospects for Improved Photovoltaic Energy Conversion Efficiencies

Abstract:

Photovoltaic solar energy conversion devices waste a major part of the incident energy. For photon energies higher than the bandgap, the excess energy is converted into heat by thermalization of excited charge carriers, while light with sub-bandgap energies cannot be harvested at all. These effects dominate the fundamental losses of single-threshold photovoltaic (PV) devices, and restrain their conversion efficiency to a little less than 34% under the AM1.5G spectrum.

Sub-bandgap losses can be remedied by the application of photonic upconversion, whereby transmitted light is converted to light of higher energy, which can then be harvested by the cell and contribute to current generation. Based on detailed balance considerations it has been shown that upconversion can boost the maximum energy conversion efficiency to about 43% under one sun for a solar cell with a bandgap of 1.76 eV, and >50% under solar concentration. Crystalline silicon cells could still reach about 38%, although the potential gain is smaller than for the high-bandgap devices.

An active field of research is the exploitation of triplet fusion (triplet-triplet-annihilation) in organic chromophores to achieve upconversion (TTA-UC). TTA-UC exploits the longevity of molecular triplet states. However, as the longevity diminishes with energy, TTA-UC is most readily applied to solar cells with bandgaps above about 1.5 eV. This talk will summarize the state-of-the-art in TTA-UC and its application to solar energy conversion.

The scientific community is invited to attend.