

Massachusetts Institute of Technology
Department of Physics

Condensed Matter Theory Seminar

“Photoluminescence: An optical heat pump for harvesting thermal losses in photovoltaics”

Carmel Rotschild, Technion: Israel Institute of Technology

Abstract: The Shockley-Queisser efficiency limit of 40% for single-junction photovoltaic cells is primarily caused by heat dissipation during energetic-photon absorption. Solar-thermo-photovoltaics attempt to harvest this heat loss, but their practical realization is challenging due to the high operating temperatures involved (i.e., above 2000 K). Conversely, we recently demonstrated how thermally enhanced photoluminescence (TEPL) is an efficient optical heat pump operating in comparably low temperatures.

The physical mechanism involves is as follows: In contrast to thermal emission, when temperature rises the photon-rate in photoluminescence is conserved while the spectrum is blue- shifted. This allows harvesting heat losses with minimal generation of entropy.

In this talk I will present our theoretical and experimental study on a TEPL solar energy converter in which solar radiation is impinging a low bandgap photoluminescent absorber that emits TEPL toward a high bandgap photovoltaic cell. We show record efficiency at comparably low temperatures.

Relevant publications:

*Manor A, et al., *Optica*, 2, 6, 585 (2015)

*Granot D., et al., *ACS Photonics*, 2016, 3 (2)

*Rotschild C., Roadmap on the Optical Energy Conversion, *IOP science, journal of optics* (accepted)

Biography

Dr. Carmel Rotschild is an Assist. Prof. at the Technion: Israel Institute of Technology, head of the lab for Excitonics at the Mechanical Engineering department, and head of the Optical Engineering course of study. He received his BSc in Optical Engineering (Mechanical Engineering) at the Technion. He did his PhD in Physics exploring nonlinear optics at the Technion, and post-doctoral at MIT studying luminescence solar concentrators. Dr. Rotschild won few distinguished awards, among them Fulbright-fellowship, Alon-fellowship, Bikura-fellowship, and Adams-fellowship. Dr. Rotschild currently holds ERC-starting grant for developing new thermodynamic ideas for solar cells and frequency up-conversion. In addition to this direction his research is focused on nonlinear-optics in small molecules, nano-photonics, organic-electronics and engineering of thermal radiation.

12:00pm
Tuesday, July 19, 2016
Duboc Room (4-331)