Tata Institute of Fundamental Research
Survey No. 36/P, Gopanpally Village, Serilingampally, Ranga Reddy Dist., Hyderabad – 500 046

Seminar

Observing Electron and Nuclear Motions in Energy Harvesting Materials Using Ultrafast Spectroscopy

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The ability to observe the movement of electrons in complex materials has been challenging due to the lack of suitable spectroscopic techniques for measuring the motion of electrons with state-specific resolution. To address this challenge, I designed and constructed a table-top ultrafast pump-probe X-ray absorption spectrometer based on high-harmonic generation (HHG), which provides element-, oxidation state-, spin state-, and geometric environment- specific electronic motion with femtosecond time resolution. In my talk, I will describe this new frontier of ultrafast science and highlight the recent applications of this method to study charge transfer excitons, electron trapping, exciton dissociation, and interfacial charge transfer dynamics in light-harvesting metal oxide semiconductors. However, a detailed understanding of these ultrafast processes also requires probing the phonon motions coupled to the electrons. During the second part of my talk, I will discuss how time-domain Raman spectroscopy can be employed to probe molecular-like phonon wave packets, lattice structural dynamics, and exciton-phonon coupling in two-dimensional perovskites. These examples illustrate the abilities and future promises of these ultrafast spectroscopic techniques to obtain a detailed nanoscale understanding of electron and phonon motions that govern rational design principles of functional materials with numerous technologically relevant applications spanning photocatalysis, photovoltaics, and information storage & processing.

Tuesday, May 9th 2023

04:00 PM (Tea / Coffee 03.45 PM)

Auditorium, TIFR-H