2024 APS March Meeting in Hong Kong

March 4th – March 8th, 2024

P4302, Yeung Kin Man Academic Building

(Purple zone)

City University of Hong Kong

RECEPTION:

Time:

6pm, Monday, Mar. 4th,2024

6pm, Friday, Mar. 8th,2024

Venue:

Purple Zone A, Yeung Kin Man Academic Building (Monday)

P4302 (Friday)

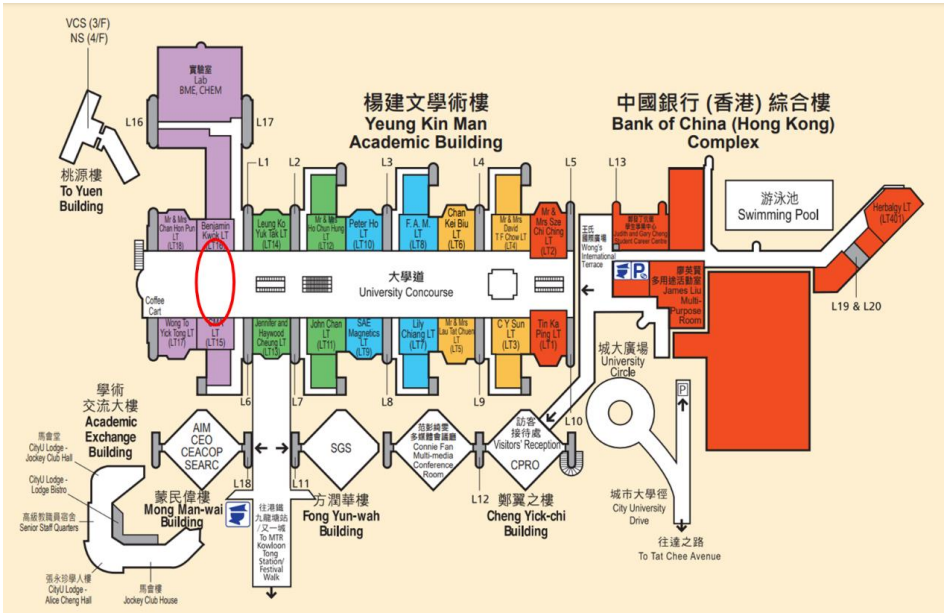
Schedule for March 4:

6pm: Reception

7:00pm Luck draw for gifs from APS and others

7:15pm: Group photo

Map:



The Purple Zone A is circled in red.

PROGRAM

Day 1 (Monday Mar. 4th, 2024)

Chair: Danfeng Li

19:30-19:45	Dielectric and phase engineering of van der Waals Sb2O3 films via PLD **Jing Yu** **University of Hong Kong**
19:45-20:00	Entangled Photons Enabled Ultrafast Stimulated Raman Spectroscopy for Molecular Dynamics **Jiahao Fan** **City University of Hong Kong**
20:00-20:15	Two-dimensional femtosecond stimulated Raman spectroscopy for molecular polaritons: dark states and beyond **Jianhua Ren** **City University of Hong Kong**

Day 2 (Tuesday Mar. 5th, 2024)

Chair: Yu Chai

19:30-19:45	Observation of Giant Spin Splitting and d-wave Spin Texture in Room Temperature Altermagnet RuO2 **Junzhang Ma** **City University of Hong Kong**
19:45-20:00	Deciphering Protein Dynamics and Evolution: Insights from AlphaFold 2's Predicted Aligned Error **Qianyuan Tang** **Hong Kong Baptist University**
20:00-20:15	Revealing the ultrafast dynamics in two-dimensional material by nonlinear spectroscopy **Shixuan Zhao** **City University of Hong Kong**
20:15-20:30	Electromagnetic asymmetry and quantum conductivity for enhanced second-harmonic generation in plasmonic nanocavity **Yaorong Wang** **City University of Hong Kong**

ABSTRACTS

19:00, Monday, Mar. 4th, 2024

Dielectric and phase engineering of van der Waals Sb2O3 films via PLD

Jing Yu
University of Hong Kong

Van der Waals dielectrics are broadly utilized to retain the intrinsic properties of two-dimensional (2D) electronic devices. As a 2D inorganic molecular crystal, Sb2O3 have attracted many research interests as a promising high k gate dielectric with low-cost and CMOS compatibility. However, fabricating 2D Sb2O3 film with controllable dielectric constant and crystal phase is challenging. Here, we designed an oxygen-assisted PLD method for the phase-selective growth of α- and β- Sb2O3 thin films with super-high κ (>100) and good homogeneity by PLD. This is realized by tuning the oxygen gas pressure in the growth products to obtain two phases Sb2O3. This phase-controlled bottom-up synthesis offers a simple and efficient way for manipulating the relevant device structures and provides a general approach for producing other multi-phase materials with unique properties and allows us to characterize their intrinsic optical and electrical properties. Using dielectric and electrical measurements, we show that α phases exhibit good dielectric performance. Our Sb2O3 dielectric film not only show higher κ than other conventional dielectrics in terms of compatibility to CMOS processes, but also keeps their comparative advantages in the fabrication of high-performance electronic devices over conventional dielectrics. Our approach of fabricating Sb2O3 dielectrics using PLD may open promising opportunities to promote such unprecedented 2D devices to industry applications.

ABSTRACTS

19:15, Monday, Mar. 4th, 2024

Entangled Photons Enabled Ultrafast Stimulated Raman Spectroscopy for Molecular Dynamics

Jiahao Fan
City University of Hong Kong

Quantum entanglement has emerged as a great resource for interactions between molecules and radiation. We propose a new paradigm of stimulated Raman scattering with entangled photons. A quantum ultrafast Raman spectroscopy is developed for condensed-phase molecules, to monitor the exciton populations and coherences. Analytic results are obtained, showing a time-frequency scale not attainable by classical light. The Raman signal presents an unprecedented selectivity of molecular correlation functions, as a result of the Hong-Ou-Mandel interference. This is a typical quantum nature, advancing the spectroscopy for clarity. Our work suggests a new scheme of optical signals and spectroscopy, with the potential to unveil advanced information about complex materials.

ABSTRACTS

19:30, Monday, Mar. 4th, 2024

Two-dimensional femtosecond stimulated Raman spectroscopy for molecular polaritons: dark states and beyond

Jianhua Ren
City University of Hong Kong

We propose a scheme based on femtosecond stimulated Raman spectroscopy (FSRS) for N molecules in an optical cavity. With theoretical simulations, the scheme can access the collective dynamics of molecular polaritons and their coupling to vibrations, along with crosstalk between polariton and dark states. Through multidimensional projections of the FSRS signal, we identify clear signatures of the dark states, e.g., pathways and timescales that used to be invisible with resonant techniques. A microscopic theory is developed for the polaritonic FSRS, which reveals the interplay between polaritonic population and coherence dynamics. The resulting signal makes the dark states visible, thereby providing a new technique for probing the dynamics of dark states and their correlation with polariton modes.

ABSTRACTS

19:00, Tuesday, Mar. 5th, 2024

Observation of Giant Spin Splitting and d-wave Spin Texture in Room Temperature Altermagnet RuO2

Junzhang Ma
City University of Hong Kong

Recently, a new magnetic phase called altermagnetism has been proposed, ushering in a third distinct magnetic phase beyond ferromagnetism and antiferromagnetism. It is expected that this groundbreaking phase exhibits unique physical properties such as C-paired spin-valley locking, anomalous Hall effect, nontrivial Berry phase, and giant magnetoresistance. Among all the predicted candidates, several room temperature altermagnets are suggested to host significant potential applications. Nevertheless, direct evidence about the spin pattern of the room temperature altermagnet is still unrevealed. RuO2 is identified as the most promising candidate for room temperature d-wave altermagnetism exhibiting a substantial spin splitting of up to 1.4 eV in previous research. In this study, utilizing angle-resolved photoemission spectroscopy (ARPES), we report experimental observation of the giant spin splitting in RuO2. Furthermore, employing spin-ARPES, we directly observed the d-wave spin pattern. Our results unequivocally show that RuO2 is a perfect d-wave altermagnet with great potential for upcoming spintronic applications.

ABSTRACTS

19:15, Tuesday, Mar. 5th, 2024

Deciphering Protein Dynamics and Evolution: Insights from AlphaFold 2's Predicted Aligned Error

Qianyuan Tang
Hong Kong Baptist University

AlphaFold 2 (AF2), an AI tool developed by DeepMind, has significantly advanced the field of structural biology. It predicts the three-dimensional structures of proteins with remarkable accuracy, solely based on their amino acid sequences. Such high accuracy has made AF2 a valuable resource in molecular biology. A key feature of AF2 is its ability to generate the Predicted Aligned Error (PAE) alongside structural predictions. The PAE quantifies the uncertainty in the prediction of the distance between a pair of amino acid residues. It was known that residue pairs with high PAE values also exhibit large fluctuations in their mutual distances during protein dynamics. Our study goes much further, by focusing on a database of protein structural changes upon ligand binding, we clearly show that the contacts with high prediction error are more likely to break during conformational changes. Based on the PAE, we study the distribution of effective strain in allosteric proteins. It is observed that proteins with large conformational motions have a higher correlation in effective strain for contacting residue pairs. This analysis allows us to identify and interpret key contacts that dictate the large-scale conformational changes of proteins. Furthermore, we show that residues with the highest PAE values significantly shape the curvature of protein energy landscapes. This research highlights the potential of AF2 to provide new insights into protein structural dynamics and evolution and potentially contribute to a deeper understanding of biological mechanisms at the molecular level.

ABSTRACTS

19:30, Tuesday, Mar. 5th, 2024

Revealing the ultrafast dynamics in two-dimensional material by nonlinear spectroscopy

Shixuan Zhao
City University of Hong Kong

The intricate interplay and dynamics between light and matter are revealed through their nonlinear interaction behavior. Ultrafast light pulses, generated by ultrafast light sources, have been instrumental in studying the instantaneous dynamics of matter. Over the past decades, ultrafast nonlinear spectroscopy techniques have been extensively employed to investigate the dynamics of atomic and molecular systems, including vibrations, potential energy surfaces, and coherence. While recently, similar approaches have been noticed and adopted to explore the ultrafast dynamics of condensed matter systems.

Few-layer Transition Metal Dichalcogenide (TMDC) materials provide a platform for investigating fundamental and intriguing ultrafast effects, such as symmetry evolution and excitonic angular momentum transfer. In this study, we employ multi-dimensional pump-probe techniques to theoretically investigate these ultrafast effects in few-layer TMDCs, focusing on their second and third-order nonlinear optical processes. By injecting hot electrons in bilayer TMDC from the excitation of Localized Surface Plasmons (LSP) of metal nanoparticles, the microscopic symmetry of each layer is disrupted by the non-uniform distribution of the injected electrons. Our findings suggest that the Second Harmonic Generation (SHG) signal can serve as a probe to characterize the distribution of injected electrons and the evolution of symmetry. Furthermore, we propose a two-dimensional quantum light pump-probe technology to characterize the angular momentum transfer process of excitons in another work.

ABSTRACTS

19:45, Tuesday, Mar. 5th, 2024

Electromagnetic asymmetry and quantum conductivity for enhanced second-harmonic generation in plasmonic nanocavity

Yaorong Wang
City University of Hong Kong

Nanoplasmon research has made significant advances in understanding nanoscale light-matter interactions within metallic nanostructures. In this talk, I will present our recent research on the nanoscale optical properties plasmonic nanocavities (nanosphere on film and nanosphere dimers) especially their nonlinear properties. Specifically, I will introduce plasmonic modes in these interesting cavities and the enhancement mechanism of second harmonic generation (SHG) through symmetry breaking and quantum conductivity. We explore the role of structural asymmetry in enhancing SHG, using the nanoparticle on film and nanosphere dimers as examples. Furthermore, we introduce a photoswitchable molecular in nanoparticle on film nanocavity, demonstrating reversible light-controlled linear and nonlinear optical tuning. The nonlinear results illustrate the significant modulation of SHG by quantum conductivity. These insights hold promise for developments in areas such as biochemical sensing, super-resolution imaging, and light-triggered energy conversion in nanophotonics.