

Department of Physics, National Central University



# Colloquium

## **Momentum-dependent nonlinear**

## optics of electrical double layer

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#### Date: 2023/12/12 (Tue)

#### Venue: **S4-625**

#### Time: 14:00-16:00

#### Abstract

Electrical double layer (EDL) controls the energy transfer and chemical reaction pathway at many aqueous interfaces, yet to characterize the interface-specific hydrogen- (H-)bonding network and ionic structure therein remains a challenge. Nonlinear optics is known as a perceptive probe to the interfacial properties, whereas the structural identification of an EDL is difficult owing to interference of various nonlinear optical responses. In this talk, I shall report our recent development of a sum-frequency (SF) spectroscopic scheme with varying photon momenta as an all–optic solution for retrieving the vibrational spectra of the bonded water layer and the ion diffuse layer, and hence microscopic structural and charging information about an interface.

Application of the method to a model surfactant-water interface reveals a hidden weakly-donor-Hbonded water species, suggesting an asymmetric hydration-shell structure of fully solvated surfactant headgroups. In another application to a zwitterionic phosphatidylcholine lipid monolayerwater interface, we find a highly polarized bonded water layer structure associating to the phosphatidylcholine headgroup, while the diffuse layer contribution is experimentally proven to be negligible.

Finally, I shall also discuss how we elucidate affinity of the hydrated protons and hydroxyl ions at the water surface through a quantitative SF-based EDL analysis, for understanding their nuclear quantum effects on the surface of a hydrogen-bonded system.