香港大學 機械工程系
Department of Mechanical Engineering
THE UNIVERSITY OF HONG KONG

SEMINAR

Coherent Mid-Infrared Frequency Combs for Multi-species Molecular Spectroscopy and Quantum-Enhanced Field Sampling

Date: **2 June, 2026 (Tuesday)**
Time: **2:00 p.m. - 3:00 p.m.**
Venue: **G/F, Tam Wing Fan Innovation Wing Two**
Run Run Shaw Building
HKU

Speaker: **Professor Sida Xing**
Shanghai Institute of Optics and Fine Mechanics
and University of Chinese Academy of Sciences
China

Abstract:
Optical frequency combs are often introduced as "rulers of light," but their deeper power lies in making optical electromagnetic fields countable, traceable, and coherently controllable. I will first introduce the basic idea of frequency combs and how they convert molecular vibrations into radio-frequency signals that modern electronics can process. In this view, spectroscopy is not only a method for identifying molecules, but a readout of carrier-fluid dynamics, isotope enrichment/dilution, and biological processes.

I will then discuss our progress toward multi-band, comb-line-resolved molecular spectroscopy. Our platform supports dual-comb spectroscopy (DCS) and electro-optic sampling (EOS), where a telecom sub-3-cycle pulse samples the mid-infrared (MIR) electric fields at the shot-noise limit. This system integrates seed combs featuring 10^{-20} fractional stability , all-fiber single-cycle pumps, and carrier-envelope-offset stable MIR combs. I will highlight the soliton dynamics enabling adiabatic single-cycle pulse formation, followed by our latest DCS measurements that resolve atmospheric $^{13}C16O2$, $12C^{17}O16O$, and $12C^{18}O16O$ isotopes in real time, together with multi-species logging and fruit breath monitoring during ripening.

Finally, I will outline future directions in high-dynamic-range multi-species spectroscopy and quantum-enhanced mid-infrared breath analysis. By combining EOS with squeezed-light detection, we aim to improve acquisition speeds and dynamic range for complex samples like human breath, where hundreds of volatile biomarkers span concentrations from percent to parts-per-trillion with over thousands of samples in a test line.

Biography:
Sida Xing received his B. Eng. and M. Eng. degrees from McGill University and his Ph.D. from EPFL, where his research centered on nonlinear fiber optics and mid-infrared light sources. He then pursued postdoctoral work in the Time and Frequency Division at NIST with Prof. Scott Diddams, focusing on few-cycle fiber combs and mid-infrared frequency-comb spectroscopy. From June 2022 to June 2026, he served as a principal investigator at the Shanghai Institute of Optics and Fine Mechanics with a professorship at the University of Chinese Academy of Sciences. He leads research on stabilized frequency combs, single-cycle pulse generation, and frequency comb spectroscopy. His current work aims to develop coherent mid-infrared field-sampling instruments for precision molecular spectroscopy, isotope analysis, and quantum-enhanced breath diagnostics.

ALL INTERESTED ARE WELCOME
For further information, please contact Professor X.B. Yin at 3910 2659.