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Ming Hsieh Institute **Seminar Series**

Semiconductors and Microelectronics Technology

Anharmonic Vibrational Dynamics in Crystals: What It Is, Why It Matters, and How Raman Spectroscopy Uncovers It

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Date: Wednesday, March 12th, 2025
Time: 10:00 – 11:30 am PT
Location: EEB 132

Abstract: Anharmonic vibrational dynamics play a crucial role in determining the physical properties of crystalline materials, impacting thermal conductivity, phase transitions, ion transport, and optoelectronic behavior.

In this talk, I will present an intuitive framework for understanding anharmonicity and demonstrate how Raman spectroscopy, combined with coupled mode models, provides a powerful tool for probing these dynamics. I will illustrate this approach through three case studies: (1) the temperature evolution of hydrogen-bond vibrations in glycine crystals, (2) soft modes and phase transitions in bismuth vanadate, and (3) electron-phonon coupling in heavily doped silicon.

A key takeaway from this analysis is that modeling with coupled mode pairs, rather than a single damped oscillator, effectively captures material behavior, bridging equilibrium and non-equilibrium dynamics and providing deeper insight into complex vibrational interactions in crystals.

Biography: Omer Yaffe is an Associate Professor at the Weizmann Institute of Science, where he leads a research group focused on anharmonic lattice dynamics. His work combines experimental techniques, particularly advanced Raman spectroscopy, with theoretical modeling to explore how lattice vibrations influence charge transport, phase transitions, and ion conduction.

Hosted by Prof. Jayakanth Ravichandran, Prof. J. Joshua Yang, Prof. Chongwu Zhou, Prof. Stephen Cronin, and Prof. Wei Wu.
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