ME Seminar

Physics- and data-driven discovery of unconventional heat flow regimes in common semiconductors

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ABSTRACT

Lattice vibrations called phonons conduct heat in crystalline semiconductors. Under many commonly encountered situations, phonon transport in these materials is broadly compliant with the Fourier's law, which states that the heat conduction is a diffusion process in which the generated heat flux is directly proportional to the applied temperature gradient, and the constant of proportionality is a material property called the thermal conductivity. In this talk, I will show that, under certain stringent experimental conditions, the phonon-driven heat flow can strongly deviate from the predictions of the Fourier's law, even in common semiconductors. For example, I will show that, within a narrow window of heating lengthscales, heat can flow like a damped wave, in stark contradiction to the prediction from the parabolic Fourier diffusion equation for heat flow. Identification of such exciting "needle-in-a-haystack" heat flow regimes was made possible by my research group's recent effort in developing data-driven approaches, motivated by physical insights, to accelerate the solution of the governing equation for phonon transport in semiconductors - the Peierls-Boltzmann equation, which is computationally intractable for such situations otherwise.

ABOUT THE SPEAKER

Dr. Navaneetha Krishnan Ravichandran (Navaneeth) is an assistant professor in the Mechanical Engineering department at IISc. He got his Bachelors from IIT Madras, and a Masters and a Ph.D. from Caltech. His research group works towards developing new materials and discovering exciting new phenomena for efficient energy transfer, by leveraging the state-of-the-art experimental and first-principles computational tools developed in his lab.

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