



Physics Colloquium

Thursday, 09 October 2025 | 17:00 – 18:00, Seminar Room 3rd Floor

Thermal Photonics for Energy and IR Lighting

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ABSTRACT

Tailoring thermal radiation is critical for applications in daytime radiative cooling, thermophotovoltaic energy conversion, solar heating, lighting, spectroscopy and sensing. At near-room temperatures, the blackbody spectrum peaks within the mid-infrared (IR) spectral range. In the mid-IR range, most dielectric materials exhibit pronounced phonon polariton resonances. In this talk, I will discuss means of harnessing such resonances in low-dimensional emerging materials to control the bandwidth, directionality, state of polarization, and chirality of thermal emission, in a lithography-free platform that holds potential for large-scale devices. These results become relevant in IR lighting, which is currently limited by the epitaxially expensive technology of quantum cascade lasers and conventional incoherent global sources. Furthermore, I will present practical approaches for enabling active tunability in thermal emission using phase-change materials. Based on these results, I will present theoretical predictions, a techno-economic analysis, and initial experimental results on actively tunable smart windows that modulate the influx and outflux of thermal radiation, thereby controlling radiative cooling in summer and solar heating in winter. Finally, I will address how harnessing thermal radiation can yield significant electricity generation with thermophotovoltaic systems.