Super-Planckian Far-Field Radiative Heat Transfer

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Understanding heat exchange via thermal radiation is key for many areas of science and engineering [1]. Radiative heat transfer between closely placed objects, with separations smaller than the thermal wavelength λ_{Th} (~10 μm at room temperature), is attracting a lot of attention because of the possibility to overcome the classical limit set by Planck's law [2-4]. However, in the far-field regime, when gaps are larger than λ_{Th}, thermal radiation is supposed to be well understood and no super-Planckian heat transfer has ever been reported.

In this talk, I will present our recent theoretical work that demonstrates that the far-field radiative heat transfer between objects with dimensions smaller than λ_{Th} can overcome the Planckian limit by orders of magnitude. In particular, I will illustrate this phenomenon with the case of suspended pads made of polar dielectrics like SiN [5]. These structures are widely used to measure the thermal transport through nanowires and low-dimensional systems and can be employed to test our predictions [6]. Moreover, to explore the limits of the violation of Planck's law in the far-field regime, I will also present our results for the super-Planckian far-field radiative heat transfer between 2D materials such as graphene and black phosphorous [7]. The ensemble of our results shows the dramatic failure of the classical theory to predict the far-field radiative heat transfer between micro- and nano-devices.

References

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Figures

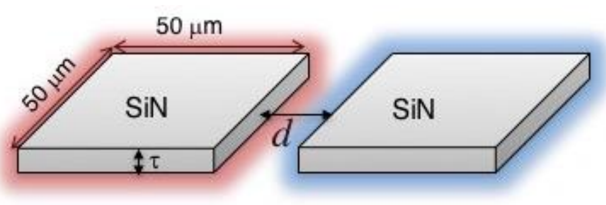

Figure 1: Far-field radiative heat transfer between two micron-sized suspended pads made of SiN.