APCTP SEMINAR

Graphene-based Josephson junction microwave bolometer

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Abstract
Sensitive microwave detectors are critical instruments in radioastronomy, dark matter axion searches, and superconducting quantum information science. The conventional strategy towards higher-sensitivity bolometry is to nanofabricate an ever-smaller device to augment the thermal response. However, this direction is increasingly more difficult to obtain efficient photon coupling and maintain the material properties in a device with a large surface-to- volume ratio. Here we advance this concept to an ultimately thin bolometric sensor based on monolayer graphene. To utilize its minute electronic specific heat and thermal conductivity, we develop a superconductor-graphene-superconductor (SGS) Josephson junction bolometer embedded in a microwave resonator of resonance frequency 7.9 GHz with over 99% coupling efficiency. From the dependence of the Josephson switching current on the operating temperature, charge density, input power, and frequency, we demonstrate a noise equivalent power (NEP) of $7 \text{X} 10^{-19}$ W/Hz$^{1/2}$, corresponding to an energy resolution of one single-photon at 32 GHz and reaching the fundamental limit imposed by the intrinsic thermal fluctuation at 0.19 K.

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