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Graphene Josephson Junction Single Photon Detector EVAN D WALSH, Massachusetts Institute of Technology, Harvard University, Raytheon BBN Technologies, GIL-HO LEE, Harvard University, DMITRI K EFETOV, MIKKEL HEUCK, Massachusetts Institute of Technology, JESSE CROSSNO, Harvard University, TAKASHI TANIGUCHI, KENJI WATANABE, National Institute for Materials Science, Japan, THOMAS A OHKI, Raytheon BBN Technologies, PHILIP KIM, Harvard University, DIRK ENGLUND, Massachusetts Institute of Technology, KIN CHUNG FONG, Raytheon BBN Technologies — Single photon detectors (SPDs) have found use across a wide array of applications depending on the wavelength to which they are sensitive. Graphene, because of its linear, gapless dispersion near the Dirac point, has a flat, wide bandwidth absorption that can be enhanced to near 100% through the use of resonant structures making it a promising candidate for broadband SPDs. Upon absorbing a photon in the optical to mid-infrared range, a small ($\sim$10 μm^2) sheet of graphene at cryogenic temperatures can experience a significant increase in electronic temperature due to its extremely low heat capacity. At 1550 nm, for example, calculations show that the temperature could rise by as much as 500%. This temperature increase could be detected with near perfect quantum efficiency by making the graphene the weak link in a Josephson junction (JJ). We present a theoretical model demonstrating that such a graphene JJ SPD could operate at the readily achievable temperature of 3 K with near zero dark count, sub-50 ps timing jitter, and sub-5 ns dead time and report on the progress toward experimentally realizing the device.

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