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A solid-state refrigerator for cooling cm-scale payloads below 300 mK[1] N.A. MILLER, D.R. SCHMIDT, J.A. BEALL, W.D. DUNCAN, G.C. HILTON, G.C. O'NEIL, L.R. VALE, K.D. IRWIN, J.N. ULLOM, National Institute of Standards and Technology (NIST) - Boulder — State-of-the-art x-ray and infrared sensors require bath temperatures near 100 mK. Currently, the two main options for cooling devices below 300 mK are the dilution refrigerator and adiabatic demagnetization refrigerator. We have developed a compact, lightweight alternative. Solid-state refrigerators based on Normal metal/Insulator/Superconductor (NIS) tunnel junctions can cool from temperatures near 300 mK to below 100 mK. The physical cooling mechanism is the preferential tunneling of the highest energy (hottest) electrons through a biased NIS junction. Recently, we have cooled both thin-film and bulk thermistors from 320 to 240 mK. Here, we present progress towards NIS refrigerators capable of cooling user-supplied payloads. In particular, we demonstrate a NIS-based refrigerator capable of cooling 6 x 6 mm^2 silicon chips. This refrigerator, in combination with a ^{3}He cryostat (base temperature $\sim$300 mK), forms a simple, compact cooling platform for ultralow temperature x-ray and infrared sensors. NIS refrigerators are fabricated lithographically on wafers, making the technology inherently scaleable to wafer-sized detector arrays.

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