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**Macroscopic Refrigeration Using Superconducting Tunnel Junctions**[1] PETER LOWELL, GALEN O'NEIL, JASON UNDERWOOD, XIAO-HANG ZHANG, JOEL ULLOM, National Institute of Standards and Technology —
Sub-kelvin temperatures are often a prerequisite for modern scientific experiments, such as quantum information processing, astrophysical missions looking for dark energy signatures and tabletop time resolved x-ray spectroscopy. Existing methods of reaching these temperatures, such as dilution refrigerators, are bulky and costly. In order to increase the accessibility of sub-Kelvin temperatures, we have developed a new method of refrigeration using normal-metal/insulator/superconductor (NIS) tunnel junctions. NIS junctions cool the electrons in the normal metal since the hottest electrons selectively tunnel from the normal metal into the superconductor. By extending the normal metal onto a thermally isolated membrane, the cold electrons can cool the phonons through the electron-phonon coupling. When these junctions are combined with a pumped $^3$He system, they provide a potentially inexpensive method of reaching these temperatures. Using only three devices, each with a junction area of approximately 3,500 $\mu$m$^2$, we have cooled a 2 cm$^3$ Cu plate from 290 mK to 256 mK. We will present these experimental results along with recent modeling predictions that strongly suggest that further refinements will allow cooling from 300 mK to 120 mK.

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