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Designing electron refrigerators for improved cooling with an expanded thermal model GALEN O'NEIL, ERIK LARSON, CU Boulder/NIST Boulder, JOEL ULLOM, NIST Boulder — Normal-metal/insulator/superconductor (NIS) tunnel junctions can act as refrigerators below 1K. Biasing the junction such that only thermally excited electrons have energy higher than the superconducting gap causes selective tunneling which cools the normal metal electrode. Because of their small size, low mass, and absence of moving parts, NIS refrigerators are an attractive cooling technology for space and industrial applications. We have demonstrated temperature reductions of 100mK from bath temperatures near 300mK. For example, we operated a superconducting x-ray detector at 160mK with a cryostat bath temperature of 260mK by using NIS junctions for the additional cooling. We will show a more complete thermal model of a large area NIS refrigerator accounting for quasiparticle injection, diffusion, and imperfect trapping. Using this model to guide NIS refrigerator design we expect to achieve our goal of cooling from 300mK to 100mK.

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