

Shot Noise in NbN/AlN/NbN Superconducting Tunneling Junctions

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Abstract—With sensitivity approaching the quantum limit, superconductor-insulator-superconductor (SIS) mixers play an important role in radio astronomy and atmospheric science at millimeter and submillimeter wavelengths. As one of the intrinsic noise sources in superconducting tunneling junctions, shot noise is still not well understood, particularly for those of relatively high energy gap (e.g., NbN/AlN/NbN).

In this paper, we mainly study the Multiple Andreev reflection (MAR) enhanced shot noise of two different NbN SIS junctions (i.e., junction array and long junction) as well as their temperature dependence. Barrier strength Z is taken into consideration for theoretical analysis of effective charge of the MAR effect based on the Blonder-Tinkham-Klapwijk (BTK) theory with the Andreev clusters method. It has been found that the effective charge of the MAR effect is inversely proportional to temperature, the barrier strength Z and transparency T are proportional to temperature. Detailed measurement results and analysis will be presented.