SQUID as a shot noise thermometer.

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Abstract

A Squid at the end of a transmission line is used as a Shot Noise Thermometry. This is done by applying a DC current larger than the critical current across the squid. For larger currents, the resistance of the squid becomes linear. The squid can then be used as a shot noise sample to calibrate the gain and the noise temperature of the circuit.

$$S_I(f,V,T,R) = \frac{k_BT}{R}\left[\frac{eV+hf}{k_BT}coth\left(\frac{eV+hf}{2k_BT}\right)+\frac{eV-hf}{k_BT}coth\left(\frac{eV-hf}{2k_BT}\right)\right] \quad (1)$$

For a digitizer with a bandwidth B and a gain G the Power is equal to:

$$P(f,V,T,R) = GB\left[k_BTn(f)+\left(\frac{R}{Z_0+R}\right)^2 S_I(f,V,T,R)\right] \quad (2)$$

$$Tn(f) = \left[T_{nc}(1-|\mathrm{T}|^2)+\frac{T_{nw}}{G_L}\right] \quad (3)$$

$$\mathrm{T} = \frac{Z_0-R}{Z_0+R} \quad (4)$$

Where, the squid resistance is R, Z_0 is the impedance of the lines (50 Ω) and Tn is the noise temperature of Network Chain. T_nc is the noise temperature at the first HEMT amplifier and T_{nw} is the noise temperature of rest of the network.