1 Proposal

Our lab (Digital Quantum Matter Laboratory) uses a dilution refrigerator to perform cryogenic circuit measurements. These refrigerators use multiple temperature stages which are thermally anchored to different temperatures. The coaxial cabling that we use to interface with the electronics in the dilution refrigerator is constructed using a series of coaxial cable segments anchored to each stage, sequentially. These cables are anchored to attenuators at each stage and transmit thermal noise to the lowest temperature stage (which is cooled to ≈ 10 mK). My goal is to construct a model for the noise induced at the mixing chamber stage by the coaxial cabling. I will use the heat diffusion equation, knowing the material properties of the cables, and the fluctuation-dissipation theorem (Johnson-Nyquist noise) to determine the amount of thermal noise present at the mixing chamber stage. A rough outline for my project will be to:

1. Determine the temperature gradient of each cable at each stage of the fridge.
2. Discretize the cable into many series resistors.
3. Determine the amount of noise generate by the series connections of resistors.
4. Time/Knowledge allowing: Determine how the thermal noise interacts with and affects a two-level quantum system (qubit).