Introduction

Axions are hypothetical particles that were proposed to solve the strong CP problem and are a theoretical candidate for dark matter. The Axion Dark Matter Experiment searches for these particles by exploiting the axion’s coupling to photons using radiofrequency cavities at low temperatures. The purpose of this project is to characterize the relationship between the cavities’ conductivity and temperature to ensure that the cavities are performing properly and are not overly lossy.

Methods

The expected relationship between copper conductivity and temperature was calculated from resistivity and temperature data.\cite{1}

Q factor and frequency data was read from the cavities during a warm up from 4K to room temperature and temperature data from sensor data from the top and bottom plates of the cavities was interpolated onto the measured Q factors. The temperature of the cavities was defined as the average temperature of the top and bottom plates and the half difference between them was defined as systematic error.

Finally, these Q factors were used to calculate the surface conductivity of the cavities using the equation:

\[ Q = \frac{(\mu_0/\mu_c) \times (V/(S \times \delta)) \times \text{(Geometry factor \sim 1)}}{[2] \}

Results

The relationship between conductivity and temperature in all 3 cavities largely follows the one predicted by the copper resistivity and temperature data, if the predicted relationship is scaled by a factor of 0.001. The reason for this scaling is not yet understood.

References


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