Using Dilution Refrigerator Technology to perform experiments on MoS2

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**Motivation**

The purpose of this research is to interpret how the properties of a 2-dimensional semiconductor can change making it a superconductor at low temperatures. In this case the 2-dimensional semiconductor is Molybdenum Disulphide (MoS2).

**Helium**

Even at absolute zero Helium does not stand still because of the Heisenberg Uncertainty principle. At this temperature they essentially vibrate. Helium is a noble gas making any force interacting with it extremely weak. However, when you have two helium atoms very close together you get a slight attraction because of the Van der Waals force between them. A He-3 atom attracts a He-4 atom more than an identical He-3 atom.

**Dilution Refrigerator**

The Dilution Refrigerator (DR) is a cryogenic device capable of cooling temperatures to near absolute zero (10mk). It uses quantum mechanics to achieve temperature below that of liquid helium (approximately 4k).

**References**

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**Conclusion**

Evaporation process was not completely effective. Aluminum layers peeled off, which resulted in a broken circuit. A possible reason for the imperfect circuit may be because the vacuum wasn’t clean. However, with an excellent circuit we can accurately measure the conductive properties of MoS2.

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**SEM and Au Evaporation**

We layer PMMA(Poly methyl methacrylate) onto the sample. Using a SEM (scanning electron microscope) we etch our design by changing the chemical properties of the areas we want. Once we have that we put the sample into a vacuum chamber where we evaporate Aluminum. Once the Aluminum sticks to the sample we can remove the rest of the PMMA.

**KLayout**

KLayout is a simple piece of software that allows users to view and create complex chip designs. KLayout is a continuously expanding free program which focuses on functionality. We used this program to design the circuit for testing the MoS2 samples.

**Molybdenum Disulphide (MoS2)**

Molybdenum Disulphide is a monolayer that when synthesized presents itself in the form of isolated triangles. A sample of MoS2 tends to have a large concentration of isolated triangles towards the center with a smaller concentration towards the outside. MoS2 triangles tend to merged with other triangles as well as be misshapen making it difficult to test.