**Homework 8**

**Pair Project**

We have decided to work on a project called **Polywells**. A Polywell is a polyhedral group of metal rings; inside each ring is a coil, which produces a magnetic field. The position of each of the rings, and the direction of current flow in each coil are set to create a null magnetic field at the center. A beam of electrons is then injected into this arrangement from opposite sides. These electrons are pushed by the magnetic fields, become trapped at the center, and form a cloud of electrons which creates a virtual electrostatic potential well.

A close up of a device

Description automatically generated



This process involves using the Lorentz force to calculate the force exerted on the electrons that push them to the center and to use the EM concepts to model a null magnetic field at the center of the Polywell. The Polywell can be used in nuclear fusion reactors (NFR). NFRs use an electrostatic potential well by using gridded electrodes, but using these results in energy loss between the grids and the ions. The Polywell overcomes this problem by replacing the physical electrodes (cathode) with the virtual cathode, which is the electron cloud.

**Details and Logistics of This Project**

This project on modeling Polywells is between Pranav Nalamwar and Revanth Mummadi. We propose to gather information about Polywells in order to model the electron cloud formed within the cavity. Furthermore, we will need to model how Polywells interact with particles within nuclear fusion reactors, either by itself or in conjunction with surrounding Polywells. Most likely, we will conduct our calculations for the Lorentz force, but it will also be important to consider interactions within the electron cloud. The electric and magnetic fields and their interactions with the particles in the NFRs must also be thought about. So far, polywell simulations in 3D have been created, but those are mainly for the electrons. We will want to focus on the ions and other particles formed through fusion.

**Sources**

<https://en.wikipedia.org/wiki/Polywell> <https://www.microsoft.com/en-us/research/video/polywell-fusion-electrostatic-fusion-in-a-magnetic-cusp/>

<https://en.wikipedia.org/wiki/Fusor>

<https://en.wikipedia.org/wiki/Inertial_electrostatic_confinement>