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Inertial Electrostatic Confinement Fusor

Cody Boyd
Virginia Commonwealth University

Brian Hortelano
Virginia Commonwealth University

Yonathan Kassaye
Virginia Commonwealth University

See next page for additional authors

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Authors
Cody Boyd, Brian Hortelano, Yonathan Kassaye, Dimitris Killinger, Adam Stanfield, Jordan Stark, Thomas Veilleux, and Nick Reuter

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What is Fusion?

Fusion is the process in which two atomic nuclei fuse to release energy in the form of neutrons. Our fusion experiments use deuterium gas (D or 2H), an isotope of hydrogen with one neutron and one proton. Fusion is achieved in a deuterium fusion reactor by injecting deuterium ions into the reactor, where a negatively charged grid sits. A large potential difference causes the ions to isotropically accelerate towards this grid, causing deuterium collisions and generating neutrons.

Our System

The inertial electrostatic confinement (IEC) fusion reactor (fusor) operates by pulling an ultra high vacuum inside a pressure vessel. Within the pressure vessel is a cathode grid that is energized with a negative electrical potential. Once the cathode is energized and the pressure in the chamber is lowered to an optimal operating point, deuterium is introduced into the system. The deuterium ions flood to the center of the chamber, causing fusion reactions. The fusor employs a data acquisition system to monitor deuterium flow rates, vacuum levels, and the power supplied to grid inside the fusor. To measure the intensity of the fusion reactions, a piece of silver foil is integrated in the fusor’s shielding, allowing it to be irradiated. Because the silver decays by means of beta radiation, the intensity of the reactions can be determined by measuring the rate of decay with a Geiger-Mueller detector.

Iterative Grid Testing

In the previous year, the only grid tested was a three loop tungsten grid with a two inch diameter. This year, a number of different grids were constructed using four different materials, each with six different geometries. The purpose of these alternative constructions is to determine if the different materials or geometries would reduce the number of surface emissions, which would improve the efficiency of the reactor.

Grid Materials:

1. Tungsten
2. Titanium
3. Molybdenum
4. Nickel

Grid Diameters:

1. 1 inch
2. 2 inch
3. 3 inch

Grid Geometries:

1. 2 Loop
2. 3 Loop

Because the D-D fusion reaction results in the production of neutrons and X-rays, shielding is necessary to protect users from the radiation produced by the fusor. A Monte Carlo n-Particle (MCNP) model was developed to calculate the necessary shielding. The shielding includes layers of HDPE and BPE that will account for neutrons, as well as beta particles, and a layer of Lead to shield x-rays.

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