Constructing and Monitoring a Farnsworth Fusor

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Background

An efficient, renewable, and clean energy source to replace petroleum fuels is a very captivating and desirable goal for humanity. Over the past few decades, the prospect of energy producing nuclear fusion, such as that occurring in the sun and stars, has been the driving force behind scientific research in nuclear fusion worldwide. A fairly simple example of a nuclear fusion device is a Farnsworth fusor, named after its creator Philo T. Farnsworth. This device is a desktop sized example of the type of high energy reactions scientist have studied in much larger and more sophisticated devices ever since the beginning of the atomic era. The method by which the Farnsworth fusor fuses atoms is called inertial electrostatic confinement and is the underlying physics principle used in some of the world's leading fusion research laboratories

Purpose

A Farnsworth style fusor, using the process of inertial electrostatic confinement, will be used to ionize trace hydrogen atoms found in the atmosphere inside of a container under vacuum. These ionized atoms will continuously accelerate towards a center anode charged by a 15 kilo-volt transformer. The accelerating ions will, in theory, fuse together creating an unstable Helium isotope which will stabilize itself by releasing energy in either the form of a proton, neutron, or gamma ray. The team will monitor the various types of radiation emitted as a result of any hydrogen fusion, heat generated by the reaction and the net power of the device. .

Design/Method

One of the main challenges associated with operating the fusor is constructing a structure for containing radiation emitted by any fusion reactions and plasma present in the chamber. The team found that an enclosure of lead plated glass or lead foil will block harmful levels of X-rays. A large container filled with water mixed with borax will provide shielding against harmful levels of high-energy free neutrons. The inverse square law of radiation intensity will also be of great importance as the team will use distance from the operating fusor as a means of further shielding.

Performance of the fusor will be monitored with a Geiger counter, non-contact temperature sensor, and a watt meter. A Geiger counter monitored with an Arduino board will be used to evaluate radiation production. This device will be used to measure alpha, beta or gamma rays emitted by any atomic collisions within the fusor chamber. A radiation dosimeter may also be used as a cheap, disposable, and remote way of measuring radiation. Energy produced by the reaction will be approximated by monitoring temperature changes with a non-contact temperature sensor. Energy consumed by the fusor will be estimated by monitoring the amount of AC power consumed with a watt meter.

As of now, the team has finished the construction of a 15 kilo-volt fusor body along with the appropriate power source, wiring, and vacuum source. This fusor is based largely off of the design and procedure outlined in *Make Vol. 36* (ISSN 1556-2336).

Results

The team expects to measure only trace amounts of radiation and neutron output. This is due to the relatively low power being applied to the fusor as well as the low amount of hydrogen-2 (also known as deuterium) atoms found in the atmosphere. As this device operates at such a relatively low voltage, no power output is expected to be measured through temperature changes in the device. As such, the net power of the device is expected to be negative. Ultra-violet light rays emitted from plasma created within the chamber are expected to be highly detectable while fast neutron production is expected to be relatively low and practically undetectable. A radiation dosimeter is predicted to detect less than 5 micro-Sieverts (μSv) (less than the average dental x-ray) being emitted by the operating fusor.

Conclusions

The team hopes to confirm predictions that the fusor will produce trace amounts of radiation as an effective example of a small scale nuclear fusion device. The device will certainly not produce any positive net energy, a state which has become the goal of multiple fusion research laboratories worldwide using exponentially higher power concepts of the fusor's fundamental nuclear fusion method.