Abstract

Plasma, one of the states of matter along with solids, liquids and gasses, is a hot, ionized gas that is composed of positively and negatively charged particles. Under specific conditions, a plasma consisting of deuterium (^{2}H) gas can be made to undergo fusion reactions. These reactions emit a vast amount of both neutral and charged particles , specifically protons, tritons, and helium-3 particles, in less than a second. The FIU Experimental Plasma Physics Group (FEPP) developed the Proton Detector, a charged fusion product diagnostic that is intended to detect the charged particles from deuterium-deuterium fusion reactions. In August, the Proton Detector, comprised of an array of 4 solid-state detectors, was installed in the Mega Amp Spherical Tokamak (MAST), where 3 out of the 4 solid-state detectors successfully observed proton, triton and possibly helium-3 emissions. The remaining detector provided data inconsistent with the other three and displayed periods supposed inactivity

It is believed that the alleged issue is due to over-saturation from the high particle rate. To verify this hypothesis, it is necessary to replicate the scenario that the detector was in and study its behavior. The Super Conducting Linear Accelerator Laboratory, located at Florida State University, would allow for this replication. The acceleration takes place in multiple stages: an ion source produces negatively charged particles; the tandem Van de Graaff accelerator then accelerates these particles up to about 10% of the speed of light; finally, the beam is turned 90 using an electromagnet and directed into the detector. The advantage of this accelerator is that multiple particles, such as helium and deuterium, can be be accelerated so that helium-3 or triton beams can be studied.

If this hypothesis is correct, it will determine whether or not the data collected from the detector in question is useful in analyzing plasma instabilities and fusion reactions. It will further serve as a benchmark warning to avoid the possibility of over-saturation in future experiments.