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Preparations for and Early Results of pB11 Tests in FF-2B Dense Plasma Focus

Abstract:

Experiments with deuterium fill gas have demonstrated that ion energies >200 keV, relevant to pB11 fusion, can be obtained in a dense plasma focus (DPF) device. Theoretical calculations and simulations show that high levels of fusion burn are possible with peak currents near 2.4 MA. These calculations have shown that in the dense plasmoids produced by the DPF electron temperature and x-ray emission will be considerably reduced through the quantum magnetic field effect. This effect, first pointed out in the 1970's, and studied in the case of neutron stars , involves the reduction of energy transfer from ions to electrons in the presence of a strong magnetic field. In a DPF plasmoid, as in most fusion plasmas, the plasma is strongly magnetized, with ion velocity closely aligned with the local direction of the magnetic field .

In a strong magnetic field, electrons can have only discrete energy levels, termed Landau levels (ignoring motion parallel to the magnetic field). With a sufficiently strong field, ions have insufficient momentum to excite electrons to the next Landau level, so little energy transfer occurs, with a reduction in energy transfer rate by as much as a factor of 25 and a similar reduction in T_e/T_i. Simulations indicate that this effect allows DPF plasmoids to reach T_i approaching 1 Mev with T_e <100 keV.

To test these predictions, LPPFusion is using isotopically pure decaborane ($B_{10}H_{14}$) as a fill gas. While it is a solid powder at ambient conditions, decaborane has adequate vapor pressure at temperatures as low as 70-100 C to provide sufficient fill pressure. We have already equipped our DPF, FF-2B with heating coils to maintain these temperatures, which are safe for the Mylar insulator sheets on the device.

After installing the exhaust line, which will convert the mix of boranes from the vacuum chamber to boric acid and hydrogen, we will start pB11 experiments using a mix of decaborane and hydrogen initially. We will report on the initial results of these tests.