Experimental investigation of magnetic-field topology via perturbation method in the PFRC-2 device

J. Matteucci[1], S. Cohen[2], …

[1]*Princeton University, 100 Stellarator Road, Princeton, USA*
[2]*Princeton Plasma Physics Laboratories, 100 Stellarator Road, Princeton, USA*

Lead-author e-mail: jmatteuc@pppl.gov

The fundamental question about FRC experiments is whether an FRC has actually formed; specifically, does there exist a magnetized, high-beta, plasma configuration with both no toroidal field and a simply connected configuration-space separatrix? We have investigated the latter part of this question, the existence of a separatrix, in the RMF_o-driven PFRC-2 device. The method involved applying an externally generated periodic RF power perturbation to open-field-line plasma at one (remote) axial end of the device while simultaneously searching for evidence of this periodic perturbation near the presumptive FRC. Measurements of the floating potential and ion saturation current were taken at the axial center of the device using a cylindrical Langmuir probe (r = 0.025 cm, L = 0.20 cm). When applying no RMF_o, measurements of the floating potential and the ion saturation current showed evidence of the frequency signature of perturbation throughout the entire radial profile of the device, indicating open field lines throughout the device. However, under certain conditions when operating the RMF_o, we found no evidence of the perturbation within a certain radius, but instead see the perturbations only beyond this particular radius, indicating a separatrix inside which the magnetic field lines are closed. Analysis of the precise nature of the perturbation within the open field plasma as well as the range of operating conditions during which evidence of a separatrix has been found are presented.