

Overview of the H-1 National Facility

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The H-1 heliac has been substantially upgraded under the Australian Government's Major National Research Facility Program, as the National Plasma Research Facility. The new systems include precision magnet power supplies, a 250kW RF source, and a 200kW 28Ghz ECH system in collaboration with NIFS and Kyoto University. The power supply allows operation to fields ~ 1 T with computer-controlled configurations; with ripple $< 0.01\%$ to eliminate induced currents. Up to 100 kW of rf power at 7 MHz is used at present to produce plasmas using helicon waves, and to produce target plasma for second harmonic ECH at ~ 100 kW. A 100,000L/s cryopump is effective for removal of water vapour, and allows quick turnaround when new experiments are commissioned. The MDSPlus data system is available for local and remote users through several channels, and carefully limited experiment control is available through a Java Interface.

At low fields, multiple diagnostic studies of these plasmas and comparison experiments with a linear helicon device suggest that the near fields of the rf antennas result in relatively high ion temperatures (20-100eV) that may increase at the edge of the plasma, even though the antennas are 3-4 cm outside the last closed flux surface. In many cases, probe and spectroscopic results indicate that there, the mass flow velocities are much less than the $\mathbf{E} \times \mathbf{B}$ velocity. Thus, radial force balance holds in detail, and the ambipolar radial electric field balances the ion pressure gradient. Correlation studies of probe and spectroscopic data yield important information about flow structures in these plasmas. In L-mode plasmas, tomographic interferometry and probe studies show low-mode-number coherent oscillations in electron density and electron and ion temperatures that are suppressed at the L-H transition. Hysteresis effects around the LH transition have been investigated by carefully programmed RF power ramping experiments.

Operation at 0.5Tesla with ~ 100 kW RF produces hydrogen and helium plasma at line averaged densities up to $2 \times 10^{18} \text{ m}^{-3}$, with temperatures apparently limited to < 50 eV by impurities such as oxygen. Similar effects occur with ECH heating at low powers. Results of initial baking and discharge cleaning regimens will be presented. Density and magnetic fluctuations in these plasmas show some correlation with magnetic configuration, particularly rotational transform.