# THE H-1NF NATIONAL FUSION PLASMA RESEARCH FACILITY

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The H-1 helical axis stellarator [1] (R/a = 1m/0.2m, $B_0$=0.2 Tesla (cont.) to 1 T (pulsed)) has been operated over a range of configurations in quasicontinuous mode at low magnetic fields ($5 < T_e < 30$eV, $T_i < 100$ eV, $B_0 < 0.2$T) for basic physics experiments for beta $<\beta> < 0.4\%$. Diagnostics include Langmuir, magnetic and Mach probe arrays and 2D $n_e$ and Doppler $T_i$. Measured current distributions (internal and external diamagnetic and Rogowski coils) agree with that derived from the 3D MHD code predictions of pressure-driven currents, (e.g. Pfirsch-Schluter currents).

Plasma is formed by helicon waves at 7 MHz, ($\omega_{ci} < \omega << \omega_{ce}$) under conditions similar to helicon sources in linear machines, but at much lower (~100 x) filling pressures. Although several diagnostics (energy analyzer, Doppler optical temperature (via MOSS [2]), and diamagnetic signals) find effective ion temperatures in the range 50-100 eV, direct ion heating by helicon waves is not expected and the mechanism for the production of high ion temperatures is not yet known. The initial charging of the plasma is consistent with expectations for rf sheath effects driven by the helicon antenna at low plasma densities [3]. The role of plasma formation RF in the plasma dynamics is investigated by analysis of antenna and RF measurements, and spatially resolved ion temperature diagnostics. Wavefield measurements taken over the band of frequencies from 0.3 to 10 MHz using a sweepable diagnostic antenna driven by a low power source reveal a rich spectrum of eigenmodes in both the helicon and Alfvén [4] wave ranges. Using a time multiplexing technique small signal measurements are made in the vicinity of the driving frequency to investigate the importance of fast wave/helicon eigenmodes in plasma production. Ion orbits are classified according to an approximate adiabatic invariant [5], (essentially a single bounce integration of the second adiabatic invariant), and a Monte Carlo transport calcuation with self consistent electric fields is compared with experimental results.

Plasma behaviour is clearly affected [6,7] by sudden changes (transitions) in confinement properties related to the radial electric field, particularly near the plasma edge. These transitions are similar to L-H mode transitions observed in most large toroidal confinement devices. The threshold for transition is affected by many parameters including configuration, RF power magnetic field and neutral pressure [8]. Transitions, thresholds and implications about underlying physical mechanisms will be discussed.

An "electronic logbook" system was developed to facilitate collaboration and remote participation. Log book entries and lines which can re-create graphs and simple analysis are cut and pasted into an emacs "info" hypertext multipart text log file, which can be edited and read by multiple users, and simply converted to a LaTeX report document, including figures, based on very little more information than would normally be kept by experimentalists in their personal log files.

The H-1 experiment was recently promoted to national facility status. The principal user group is the Australian Fusion Research Group, representing various universities around Australia, under the umbrella of the Australian Institute for Nuclear Science and Engineering. Following these upgrades, ECH experiments are scheduled to start in late 1988 with a 28GHz gyrotron obtained under a collaborative agreement with the NIFS and Kyoto groups.


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## References


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The complete set of posters can be found at http://rsphysse.anu.edu.au/~bdb112/icpp98.html and the facility is described under http://rsphysse.anu.edu.au/prl/