Abstract

A new spectrometer diagnostic on the National Spherical Torus Experiment (NSTX) monitors the density distribution of ions in the plasma edge region with spatial and temporal resolution. Observations of anisotropies measured with this diagnostic are only consistent with parametric heating of the ion populations, which is well correlated with the period of RF power application to the plasma. Temperature measurements suggest that populations of ions are present and these populations have a range of temperatures. High electron temperatures are present in the plasma edge region, and the effect of RF heating is most pronounced in the toroidal heated region. These observations indicate that RF heating plays a role in creating the observed anisotropies in the plasma edge region.

Summary

- Launched HHFW leads to core electron and poloidal edge ion heating in NSTX.
- Applying power to the RF antennas coincided with large amounts of carbon influx.
- This carbon influx is a charge exchange diagnostic.
- Anisotropic ion temperatures are measured, consistent with an enhanced perpendicular energy content.
- The launched HHFW undergoes parametric decay into an IBW and an ICQM, which damp in the outer 70 cm of the plasma.
- IBW's are confirmed in these plasmas by Langmuir probe measurements.
- Edge ion heating is observed in all HHFW plasmas.

Line shape w/ RF is better fit with a 2-Gaussian distribution.

When HHFW RF power is applied to NSTX, the transition in C(IV) and He II spectral line shapes becomes evident.

Fitting with 2 Gaussians accurately represents the data and reveals a non-thermal distribution function of "hot" and "cold" ions in the same radial location in the edge of the plasma.

The poloidally measured distribution has a systematically higher temperature than the toroidally measured distribution, for a given RF input power.

Core electron and edge ion heating is observed.

Electron heating from HHFW is expected and observed.

Edge ions are measured at 280 eV and 370 eV, both sub-thermal of the HHFW and should not be affected by the launched waves, but are.

The period over which these edge ion heating is observed exhibits extra-ordinary power with the period of RF power application to the plasma.

A new thermal and toroidal equilibrium is established.

Charge exchange with RF antenna sourced carbon impurities reveals hot edge ion dynamics.

The powered RF antenna acts as a source of neutral particles at the edge of the plasma.

In the poloidally resolved (≈ 33 cm from the RF antenna) toroidally, the brightness of Ce IV transitions by a factor of 4 times the brightness of Ce IV transitions by a factor of 4.

A portion of the HHFW undergoes nonlinear processes, while the other portion produces a parametric decay into an IBW and an ICQM, which damp in the outer 70 cm of the plasma.

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As a given RF power is increased, the poloidally measured temperature is found to be higher than the toroidally measured temperature, by approximately the temperature of the magnetic pinch field.

Langmuir probe measurements confirm the presence of IBW's.

Negative poloidal velocity is expected on the rotational transform. Negative velocity is observed in the direction of the rotation transform.

As a given RF power is increased, the poloidally measured temperature is found to be higher than the toroidally measured temperature, by approximately the temperature of the magnetic pinch field.

Edge ion heating observed in many plasmas.

Parametric heating of edge ions is observed in all NSTX plasmas with applied HHFW power.

Antenna phased at 14, 7, and 3.5 m.

He and D2 filled discharges: 1 Upper single null, 1 Lower single null, and Double null.

Variation, Lp, and E0 values.

Overview of the Edge Rotation Diagnostic (ERD)

- Detailed description available at http://w3.pppl.gov/~tbiewer/RSI_ERD.pdf
- Data from NSTX C, C IV, and D plasmas
- Time scales from tens of microsecond to milliseconds.