Overview of Results from the Upgraded ICRF System on Alcator C-Mod

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Alcator C-Mod ICRF system overview

Two 2-strap antennas at D- and E-port
  • Each antenna connected to one 2 MW 80 MHz transmitter

Upgrade (collaboration with PPPL) - one new 4-strap antenna at J-port
  • Connected to two 2 MW 40-80 MHz transmitters
J-port (0,180,0,180) heating identical to D- and E-port

H-mode comparison:

L-mode comparison:
J-port antenna modifications

Installed low inductance electrical connection between back plates
Protected ceramic washer assembly with stainless steel cups
Aligned protection tiles and modified fastener assembly
RF-bypassed ends of antenna backplane

[UP1.102], [UP1.104]
Demonstrated > 4 MW injected RF heating power from combined systems

Total RF power now up to 5 MW
Stored energy now up to 0.23 MJ

Peak $T_e$ on axis now up to 5 keV
Neutron rate now up to $1.8 \times 10^{14} \text{ ns}^{-1}$
ICRF-driven rotation experiment results

Toroidal rotation does not change direction when minority resonance moved from high field side to low field side, contrary to theory predictions [UP1.093]

New internal transport barrier appears in addition to H-mode edge barrier when minority resonance moved to high field side [UP1.103], [J01.002]
Evaluate the impact of insulating limiters on antenna performance

Installed BN tiles on E-port antenna 3/2000 to compare with D-port antenna

Results fine, installed BN tiles on all antennas 7/2000

How do BN tiles change:

- Antenna conditioning behavior - no change observed so far
- Antenna disruption recovery - no change
- RF impurity production - no change within 5 MW power levels achieved so far
Now develop RF physics basis to utilize RF as a physics tool

Heating - couple > 5 MW of ICRF power to the plasma
• Investigate minority and mode conversion heating [J01.009], [J01.008], [UP1.105]
• Antenna loading issues
• RF impurity generation

Develop capabilities to control $E_r$
• Investigate RF driven toroidal rotation
• Investigate poloidal flow drive

Develop capabilities to control current profile
• Investigate RF current drive efficiency
• Develop means to suppress sawteeth
Summary

The C-Mod ICRF system has been upgraded through the addition of two transmitters and a new 4-strap antenna.

Heating power will be doubled to 8 MW (source) at ~ 80 MHz, have achieved 5 MW into plasma so far.

Heating and current drive power of 4 MW (source) will be available at 43, 60, 70, and 78 MHz.

This upgrade considerably extends the range of physics investigations possible on the C-Mod tokamak.