1. Purpose of Experiments

The purpose of this experiment is to try to maximize the performance characteristics of ITB discharges. In spite of the fact that C-Mod ITBs exhibit large internal pressure gradients, they have been criticized for having unremarkable core temperatures and global confinement. This of course may be inherent to high density ITBs with strongly coupled electrons and ions. However, since conditions will be similar in a reactor setting it is important to improve ITB parameters in C-Mod. Another goal is to increase the bootstrap current.

2. Background

In most previous ITB experiments [1,2,3], the total ICRF power levels have been less than 3 MW, the toroidal magnetic field has been 4.5 T and the target EDA plasma H-factor has been low, typically 1.2. As such, the central ion and electron temperatures have been modest, around 1500 eV. Small amounts of additional on-axis heating power ($P_{on-axis}/P_{off-axis} \sim 0.3$) have had the beneficial effects of raising the core ion temperature, maintaining steady electron density profiles and arresting impurity peaking [2,3]. Unfortunately, raising the on-axis power above this level causes the ITB to degrade [3], so another approach must be found for raising the core temperatures.

3. Approach

The proposed approach for improving ITB plasma parameters is one of brute force, to operate at full ICRF power, into a target plasma with higher temperature and H-factor.
Injection of ICRF power in excess of 6 MW is required, with all antennas at 80 MHz, into an EDA target plasma with the highest possible H-factor, in the 1.7 range. Operation at 6.1 T with the resonance on the low field side will maximize the central temperature in the ohmic target plasma, and operation at 1.2 MA will also increase the ohmic input power. 6.1 T should also allow for ECE temperature profile measurements. Unfortunately with all of the ICRF power off-axis these ITBs will be transient.

4. Resources

4.1 Machine and Plasma Parameters

   Give values or range for:

   Toroidal Field: 6.1 T
   Plasma Current: 1.2 MA
   Working gas species: D(H)
   Density: EDA target

   Equilibrium configuration (if possible, refer to database equilibria):

   Pulse length, typical current & density waveforms, etc. Refer to database or sketch desired waveforms:

4.2 Auxiliary Systems

   RF Power, pulse length, phasing: Maximum power and pulse length at 80 MHz
   Pellet Injection (species):
   Impurity blow-off injection:
   Diagnostic Neutral Beam:
   Special gas puffing:
   Other:

4.3 Diagnostics

   List required diagnostics, and any special setup or configuration, e.g. non-standard digitization rate.

   Thomson scattering, ECE, visible bremsstrahlung, HIREX and HIRICES-Jr, DNB

5. Experimental Plan

   Both sections must be filled in.

5.1 Run sequence plan

   Specify total number of runs required, and any special requirements, such as consecutive days, no Monday runs, extended run period (10 hours maximum), etc.

   1 run day in a well conditioned machine, with reliable ICRF power from all antennas.
5.2 Shot sequence plan

For each run day, give detailed specification for proposed shot sequence: number of shots at each condition, specific parameters and auxiliary systems requirements, etc. Include contingency plans, if appropriate.

Establish high H-factor EDA target plasma without ITB, $B_T \leq 6$ T; 5 shots. Fine tune high performance ITB plasma with $B_T = 6.1$ T; 5 shots. Obtain high quality $T_e$, $T_i$, $n_e$ and $V_{Tor}$ profiles, including scanning the DNB timing relative to the ITB evolution; 10 shots.

6. Anticipated Results

Discuss possible experimental outcomes and implications. Indicate if the program may be expected to lead to publications, milestone completions, improved operating techniques, etc. Indicate if the experiments are intended to contribute to a joint research effort, or an external database.

ITB trophy shot, competitive with other devices, to be presented at the IAEA meeting and in Davis Lee thesis.

7. References

Include references both to external and internal literature or communications which bear on this proposal. See Section 2.

