1. Purpose of Experiments
The purpose of this experiment is to sort out the field/current/q dependence of the ITB foot location by scanning current at a higher fixed value of magnetic field than has been done previously. Gaining insight into this dependence will help to sort out the physical explanation of the Alcator C-Mod ITBs.

2. Background
Research on producing and controlling of ITBs using off-axis ICRF in Alcator C-Mod is ongoing [1-5]. Earlier work on the foot location in enhanced neutron mode ITBs suggested that the foot location scales decreases with increasing q95[2]. Later studies have found that the ITB position narrowed with increasing magnetic field[4]. A scan of ITB foot position as a function of current at fixed field showed a possible positive correlation, but not as strong as that with magnetic field[5].

3. Approach
The approach is to scan the plasma current from 0.6 to 1.2 MA at a magnetic field of 5.4 T using the 70 Mhz ICRF off axis on the low field side to establish an ITB plasma. The foot position will be determined at each current step.

If the run goes very well, the field can be raised to 6.3 T and a current scan could also be obtained using the 80 Mhz ICRF off-axis to establish the ITB.

Note on the choice of frequency: Use of 70 Mhz has been requested because this allows operation at higher fields where the ECE diagnostics are not cut-off by
the rising density in the ITB. There are several advantages of having the ECE data: 1. The high time and spatial resolution improve the accuracy of the transport analysis and stability modeling; 2. Sawtooth heat pulse analysis of the barrier can be done directly from the temperature sawteeth which is less ambiguous than using the soft x-ray emission; 3. The Texas-FRC group has seen some interesting density fluctuations on some ITB plasmas where their ECE signal is not cut off, and further study of these would be useful. If only 78 Mhz is available, this scan should be done at 6.3 T (it has already been done at 4.5 T).

4. Resources

4.1 Machine and Plasma Parameters

Toroidal Field: 5.4T or best for establishing the ITB

Plasma Current: 0.8 MA

Working gas species: D, H minority


Equilibrium configuration : Shot 1021024017

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

Setup as shot 1021024017

4.2 Auxiliary Systems

RF Power, pulse length, phasing: 80 Mhz, 70 Mhz, > 2MW as available, heating phasing.

Pellet Injection (species): none

Impurity blow-off injection: none

Special gas puffing: none

Other:

4.3 Diagnostics

Hirex for Ti profiles and rotation

Thomson Scattering
Visible Bremsstrahlung array

GPC 1 and 2, FRC-ECE

Neutron diagnostics

Beam diagnostics (CHERS, MSE, BES) desirable

All standard core diagnostics

4.4 Neutron Budget

less than $5 \times 10^{15}$

5. Experimental Plan
Both sections must be filled in.

5.1 Run sequence Plan
The run can be completed in 1 day.

5.2 Shot sequence plan

Reproduce ITB from 1021024017 (1-5 shots). This will serve as the 0.8 MA case.

Lower the current to 0.6 MA and obtain an ITB (3 shots).

Raise the current to 1.0 MA and obtain an ITB (3 shots)

Raise the current to 1.2 MA and obtain an ITB (3 shots).

If time allows, raise the field to 6.3 and repeat with the 80 Mhz ICRF.

6. Anticipated Results
We hope that this will definitively establish the field/current/q dependence of the ITB foot location and point us in the right direction for sorting out the causal mechanisms, such as magnetic versus ExB shear in forming these ITBs. It is anticipated that this work would be published in Plasma Physics and Controlled Fusion and be featured in an EPS invited talk in June '04 if successful.

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

[1] Rice et al., NF 41, 277 (2001)


[5] Fiore et al., submitted to PoP