1. Purpose of Experiments
Include immediate goal of the experiments, scientific importance and/or programmatic relevance. Refer to any relevant program milestones.

This experiment is intended to expand the range of toroidal magnetic field $B_T$ present in the H-mode pedestal data set, and thus resolve the scaling of edge pedestal parameters on $B_T$ and on edge safety factor $q$.

2. Background
Discuss Physics Basis of the proposed research. Prior results at Alcator or elsewhere, and any related work being carried out separately.

Formation of edge pedestals in edge temperature and density routinely accompanies edge transport barriers in C-Mod and other tokamaks. The elevated pressure immediately inside the plasma separatrix is correlated with increased stored energy in H-mode. Because of this link between global confinement and the boundary condition established by the edge pedestal, the scaling of pedestal parameters with operational parameters is of great interest, particularly in view of extrapolating to future devices.

Previous pedestal scaling studies [1] on C-Mod took advantage of steady-state EDA plasmas with ICRF heating, obtained over a range of current, density and field. Multiple regression analysis of the data set showed that the $n_e$ pedestal height and width scaled with the inverse of $B_T$. The strength of the scaling was uncertain, due to both the level of scatter in the data and the relatively narrow range of the independent variable ($4.5 < B_T [T] < 6.0$). Interestingly, the scaling of the $n_e$ pedestal width $\Delta n$ with $1/B_T$ is qualitatively similar to recent results obtained by Chang using the XGC code [2] to analyze the neoclassical transport and pedestal build-up in a DIII-D equilibrium. We seek to test the scaling by obtaining good pedestal data at fields outside the aforementioned narrow range of $B_T$. This test can best be accomplished using the tuning capability of the
J-port RF transmitters to deposit auxiliary power near the plasma center at fields considerably lower than the nominal 5.4T.

In the prior studies, $\Delta_n$ further demonstrated a scaling with plasma current $I_P$, suggesting a possible dependence: $\Delta_n \sim 1/q$. Such a scaling may indicate a connection between transport in the EDA H-mode regime, the character of which depends strongly on edge $q$, and the $n_e$ profile shape. By expanding the scaling study to a larger range in field (and safety factor), we can determine whether the dependence of $\Delta_n$ with $B_T$ (or $q$) persists at lower fields and in the ELM-free operational regime. Simulations can then be run with XGC can be run on C-Mod equilibria for comparison.

3. **Approach**

Describe the methodology to be employed; explain the rationale for the choice of parameters, etc. Describe the analysis techniques to be employed in interpreting the data, if applicable. If the approach is standard or otherwise self-evident, this section may be absorbed into the Experimental Plan.

This experiment requires equilibria with the same shape and ICRF power deposition near the plasma center (within $r/a$ of about 0.5). $B_T$ will be varied from 2.9 to 6.0T with 50MHz ICRF from J-port heating at the low fields and 78MHz from D and E heating at the high fields. Plasma current will be varied at each field as well, so that pedestal scaling with edge $q$ can be assessed. In all shots, 2-3MW of RF power are desired.

Both EDA and ELM-free H-modes are likely to be triggered. In addition to tracking pedestal behavior as the regime is varied, density fluctuations from PCI should be measured. Further information on radial particle transport may be obtained from D-alpha emissivity as inferred from Xybion camera measurements. Probe scans in the SOL region, if available, could prove useful as well.

4. **Resources**

4.1 **Machine and Plasma Parameters**

Give values or range for:

- **Toroidal Field**: 2.9-6.0T
- **Plasma Current**: 0.5-1.2MA
- **Working Gas Species**: $D_2$
- **Density**: $n_{04}=0.8x10^{20}$
- **Equilibrium configuration (if possible, refer to database equilibria)**: LSN, as on 1040122001

4.2 **Auxiliary Systems**

- **RF Power, pulse length, phasing**: 2-3MW, flat for 1 sec; heating phasing, J @50MHz and D+E @78MHz
- **Pellet Injection (species)**: Impurity blow-off injection:

April 2, 2004
**4.3 Diagnostics**

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

Edge and core Thomson scattering, ECE, TCI, PCI, Xybion camera, scanning probes (if available).

**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.

One successful run day should be sufficient to complete this proposal. Successful operation of 50MHz ICRF into plasma shall have been demonstrated prior to this run occurring.

**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.

1.) Begin with J-port at 50MHz:
   - Shots 001-004: \( B_T = 3.4T, I_P = 0.5 \) and \( 0.8MA \). (2 shots at each current)
   - Shots 005-008: \( B_T = 2.9T, I_P = 0.5 \) and \( 0.8MA \). (2 shots at each current)
   - Shots 009-012: \( B_T = 3.8T, I_P = 0.5 \) and \( 0.8MA \). (2 shots at each current)

2.) D,E at 78MHz:
   - Shots 013-018: \( B_T = 5.3T, I_P = 0.5, 0.8 \) and \( 1.2MA \). (2 shots at each current)
   - Shots 019-024: \( B_T = 6.0T, I_P = 0.5, 0.8 \) and \( 1.2MA \). (2 shots at each current)
   - Shots 025-030: \( B_T = 4.6T, I_P = 0.5, 0.8 \) and \( 1.2MA \). (2 shots at each current)

30 shots are required.

**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.

Improved scalings of the pedestal with plasma parameters give greater insight into the physics governing transport barrier formation and extent. A positive result will give greater range to local and collaborative pedestal parameter databases, and could lead to better physical understanding of the transport barrier. In particular, a positive comparison...
with computation is possible. The data would form a useful contribution to the Hughes’s thesis.

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