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

The purpose is to characterize broad-band magnetic fluctuations associated with plasma turbulence in the vicinity of the magnetic separatrix.

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

Recent analysis of plasma pressure gradients near the separatrix and their dependence on plasma conditions [1] suggest that electromagnetic fluid drift turbulence (EMFDT), as contained in state-of-the-art non-linear plasma turbulence models [2-4], control the level of transport in this region. These models identify two key parameters, pressure gradient and collisionality, as controlling the level of plasma transport. Natural normalizations for these quantities (e.g., $\alpha_{MHD}$ and $\alpha_d$) are suggested by the system of equations which describe EMFD physics. Recent findings show that the edge plasma state near the separatrix in C-Mod lies on a well defined curve in this two-parameter space ($\alpha_{MHD}, \alpha_d$) over a wide range of discharge conditions in ohmic L-mode (see Fig.1). These data strongly support the hypothesis that EMFDT turbulence plays a dominant role.
Figure 1. The system of equations which describe EMFD physics [2-4] identifies dimensionless parameters which characterize the plasma pressure gradient ($\alpha_{MHD}$ or $\hat{\beta}$) and the plasma collisionality ($\alpha_d$ or $\hat{C}$). In turbulence simulations, the transport fluxes are usually found to be strong functions of these parameters. In experiments, the energy and particle fluxes are the parameters which are truly “controlled”; gradients relax or sharpen according to the transport to satisfy particle and energy balance. Therefore, in experiments, one might expect the normalized pressure gradient to be tied to the normalized plasma collisionality, mapping out a curve in this two-parameter space. This figure shows that such a behavior is in fact observed in the edge plasma of C-Mod at a location 2 mm outside the magnetic separatrix.

Based on turbulence simulations, Rogers, Drake, and Zeiler [3] identified two regimes in the ($\alpha_{MHD}, \alpha_d$) phase-space: a non-linear drift-wave regime for $\alpha_d > \sim 0.4$ and a resistive ballooning regime for $\alpha_d < \sim 0.4$. It is interesting to note that the data in Fig. 1 show a substantial reduction in $\alpha_{MHD}$ for $\alpha_d < \sim 0.4$, perhaps consistent with the onset of a strong ballooning character. However, it should be noted that RDZ’s interpretation is not universally accepted. Scott argues that RDZ’s analysis is incorrect and that the character of the turbulence remains drift-wave dominated [5].

Regardless of the controversy, the observations of RDZ raise some important questions: Does the character of magnetic fluctuations in the experiment change in any significant way with normalized collisionality ($\alpha_d$ or $\hat{C}$)? What, if anything, does this
say about the relative role of ballooning versus non-linear drift-wave turbulence as $\alpha_d$ is varied? And, more simply, what do the broad-band magnetic fluctuation spectra (frequency and wavenumber-resolved) look like near the separatrix in the plasma turbulence associated with ohmic L-mode?

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.

Our approach is very simple and straightforward. We will use the two-coil magnetic probe head installed on the A-port drive (ASP) to record broad-band poloidal magnetic field fluctuations (frequency and k-poloidal resolved) as a function of depth in the scrape-off layer. We will ‘dial-up’ ohmic L-mode discharges identical to those in Fig. 1 and record fluctuation spectra over a range of $\alpha_d$.

4. Resources

4.1 Machine and Plasma Parameters
Give values or range for:

- Toroidal Field: 5.4 tesla
- Plasma Current: 0.8 MA
- Working Gas Species: $D_2$
- Density: $NL04 = 0.5$ to $1.5 \times 10^{20}$ m$^{-2}$
- Equilibrium configuration (if possible, refer to database equilibria): Standard LSN with probe targeting optimized

4.2 Auxiliary Systems

- RF Power, pulse length, phasing: None
- Pellet Injection (species):
- Impurity blow-off injection:
- Diagnostic Neutral Beam:
- Special gas puffing:
- Non-axisymmetric Coils (Connections, Current):
- Other:

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

ASP with two-coil magnetic head installed, FSP, ISP.
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.

1/2 Run

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.

Dial up 0.8 MA, 5.4 tesla, ohmic L-mode, LSN discharges.
Vary density over range of NL04 = 0.5 to 1.5x10^{20} m^{-2}.
Scan FSP and ISP probes three times during each shot.
On a few shots, hold ASP at a fixed location approximately 1 cm from separatrix.
Otherwise, scan ASP at three times during each shot.
Optimized plasma position for probe targeting.
15 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.

Poloidal magnetic field fluctuation spectra will be recorded for a range of plasma collisionalities. These will help us make contact with the role of electromagnetic fluid drift turbulence in controlling plasma transport across the magnetic separatrix.

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