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

The goal of the experiment is to inject impurities in the pedestal in order to cool off the pedestal and affect the quasi-coherent fluctuations in an ELMy H-mode. The local injection of impurity in the pedestal will be performed using the laser blow system.

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

Previous pedestal experiments on C-Mod [1] indicated that edge quasi-coherent magnetic fluctuations limit the pedestal evolution (see figure 1). In addition, these fluctuations are found to be edge localized. The onset of these fluctuations is found to be consistent KBM, a key ingredient in EPED. The QCF’s amplitude evolution is correlated with the temperature evolution as shown at the bottom of figure 1. This result was also observed on the DIII-D tokamak [2]. Here we would investigate in a more controlled way the effects of the temperature on the amplitude of the QCFs by cooling the edge pedestal without affecting the core parameters. Such approach for cooling the edge is motivated by the results on 1120607013 which shows in figure 2 the cooling of the edge. Such cooling might lead to a delayed onset of the QCF without affecting the core parameters.
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.

For this work, an ELMy H-mode is to be reproduced with same characteristics as in figure 1. Then, a laser blow on calcium will be injected to attempt to cool off the edge pedestal in order to keep the pedestal temperature a level below the onset of the QCFs.

Edge Thomson measurements and a suite of fluctuations measurements are required to quantitatively estimate relative changes of the fluctuation levels. Such measurements should include the reflectometers (both SOL and pedestal), PCI and fast-TCI for density fluctuations, the GPI for estimate of the radial and poloidal wavenumbers, the magnetic probes. In order to better characterize the edge fluctuations, we will use the latest-generation magnetics probe head attached to the ASP, and dwell close to the edge of some modestly powered H-modes.

In order to obtain clean, steady H-modes, an overnight boronization will be required before the run. Thus several shots of boronization recovery will be needed in the morning of the experiment, and the initial H-modes will have large amounts of wall fueling. Several discharges with significant RF input power will be needed to reduce the intrinsic particle sources and obtain low density H-modes. ELMy H-modes will be obtained with moderate elongation (kappa <= 1.55), a weakly shaped crown (delta_u ~ 0.2) and an outer strike point either in the divertor slot or very low on the vertical plate (delta_l > 0.7). This is the so-called “JFT-2M” shape. The reference shot is 1120815027.

Once in ELMy regimes, injection of LBO will be attempted to cool off the pedestal in order to demonstrate control of the QCFs.

Profiles in ELMy H-mode must be analyzed according to their timing within the ELM cycle. The mechanism to do this exists for the Thomson data, via the python tools imported from GA by T. Osborne.

4. Resources
4.1 Machine and Plasma Parameters

Give values or range for:

- Toroidal Field: 5.4T & 8T
- Plasma Current: 0.7 – 1.0 MA
- Working Gas Species: D2
- Density: 0.4 – 0.8 x 10²⁰ m⁻³

Boronization Requested (if yes, specify whether overnight or between-shot, how recently needed, and any special conditions.): yes, overnight

Equilibrium configuration (if possible, refer to database equilibria): kappa<=1.55, delta_u~0.2, delta_l~0.8 (e.g. 1110107030)

4.2 Auxiliary Systems

- ICRF Power, pulse length, phasing: 2—4MW, D(H) heating
- LHCD Power, pulse length, phasing: none
- Pellet Injection (species): none
- Impurity blow-off injection: YES calcium?
- Diagnostic Neutral Beam: not required
- Special gas puffing: NINJA with D2 for CXRS, He for GPI fluctuations; Ar for Hirex Sr
- Cryopump: no

Non-axisymmetric Coils (Connections, Current); standard locked-mode correction

Other:

4.3 Diagnostics

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

Core/edge TS with both lasers. Edge CXRS. Hirex Sr.
Bolometry. All available D-alpha, Ly-alpha diagnostics
X-mode reflectometer (if available), O-mode reflectometer, PCI, fTCI, GPI, magnetics, shoelace antenna in receiving mode
ASP with magnetics probe head
XTOMO 2 and 4 outboard x-ray cameras (if available) with small Neon puffs.

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.

I run day, following an overnight boronization would be needed to obtain the data in this experiment, should it be stand alone. However, if it can be combined with another ELMy H-mode experiment, then we would like to request 5 ELMy discharges in piggyback
allowing the injection of impurity at 5.4 T and 8T. Note injection of calcium using LBO should not result in core performance degradation.

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.

Initial shots will be used to recover ICRF operation following boronization. The first H-modes will be high-density EDA H-modes at moderate amounts of RF power. By systematically reducing density over the course of the day, ELMy H-modes will be obtained.

1. Load from 1120815027. Set target nl04 to 1.0x10^{20} \text{ m}^{-2}. Apply ICRF power after 0.6s. Recover from boronization.
   Inject the LBO at 10 Hz throughout the discharges (2 shots)
   Attempt to vary the injection rate (2 shots + 1 contingency)
   During the shots, obtain magnetic and density fluctuations using the reflectometer and the magnetic probe.
   Generate locked modes for XICS calibrations

5. 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, an ITER request, or an external database.

The experiment will extend our knowledge of the dynamics of pedestal evolution in conventional H-mode, a major goal of ongoing ITPA research.

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