1. Purpose of Experiments
   Include immediate goal of the experiments, scientific importance and/or programatic relevance.
   Refer to any relevant program milestones or ITER R&D commitments.

   The goal of this mini-proposal is to provide several high density shots for the calibration of the reflectometer.

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

   A key element of the operation of the reflectometer is its absolute calibration. In order to get the successful profile inversion, the location of the plasma edge and the phase measured there should be known. In the current system, we only have the data measured before and after discharging as the reference to deduce the phase of the plasma edge. Those data are assumed to be reflected from the tiled inner vacuum wall. However, the several runs before APS97 showed there could be large errors if using them as the references.

   If we produce high SOL density shots, phases from all channels of reflectometer (may not applicable for the highest-frequency channel) will become constant values after the density passes some thresholds. If the measured constant values changes little when we change the outer gap, we can assume that the phases measured come from the radius of limiter—the only fixed restriction of plasma. On the other hand, from the known position of limiter, we can use the data to calibrate the reflectometer. The calibration should be better than using inner wall as the reference. (Ref. Paul Stek’s PhD thesis, p99)

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.

   See experimental plan. Choice of parameters is essentially the easiest way to obtain the plasmas we expect.
4. Resources

4.1 Machine and Plasma Parameters

Give values or range for:

Toroidal Field: 5.3T

Plasma Current: 800kA

Working gas species: D

Density: Ramping up to $\bar{n}_e \sim 4.0 \times 10^{20} m^{-3}$

Equilibrium configuration (if possible, refer to database equilibria): Single-null divertor, varying the outer gap.

Pulse length, typical current & density waveforms, etc. Refer to database or sketch desired waveforms: Similar to the shot 951206031.

4.2 Auxiliary Systems

RF Power, pulse length, phasing: None

Pellet Injection (species): None

Impurity blow-off injection: None

Special gas puffing: Yes.

Other:

4.3 Diagnostics

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

TCI and reflectometer are operational.

4.4 Neutron Budget

Estimate the neutron dose rate at the site boundary. Give basis for estimate. (Once some experience has been gained a standard formula will be provided for estimating dose rates.)

$< 10^{13}$

5. Experimental Plan

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.

4–5 shots
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.

Shot 1: A linear density ramp with the $\bar{n}_e$ up to $4.0 \times 10^{20} m^{-3}$ will be performed. Outer gap is standard.

Shot 2: The same density as shot 1, but with less outer gap (<0.5cm).

Shot 3: With the same density of shot 1, vary the outer gap from the 2cm to less than 0.5cm after $\bar{n}_e$ reaches $3 \times 10^{20} m^{-3}$.

Shot 4: Repeat shot 3.

Shot 5: With the condition of shot 3, reduce the outer gap to be minimal in the last 50ms of density ramping.

For all shots: Gas puffing valve should be open and make the control system get the density required. If the target density cannot be reached by 800kA, 1MA is needed.

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.

If the plasma is really limited at some position, all channels of reflectometer should become fixed at some phases one by one from the lowest frequency channel during the density ramp. And the phases should change little during the varying of the outer gap. If it is this case, the reflectometer can get better calibration by introducing some phase offsets.

7. References

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