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

The purpose of this experiment is to investigate with full diagnostic capability the Quasi-Coherent Mode (QCM) in an Upper Single Null (USN) magnetic configuration.

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

The origin and characteristics of the QCM have been of interest ever since it was clear that it was responsible for the enhanced particle transport through the pedestal in C-Mod’s EDA H-mode. Theoretical explanations for the QCM are still lacking. When the QCM was investigated with MP#442 – “Radial Structure and \(k_{\theta}\) Variation of the QC Mode” (1st half of run 1051202), a number of new observations were made, including:

1) a clear harmonic was seen at twice the frequency of the fundamental and with twice the poloidal wave-number – see figure 1;
2) the existence of the harmonic oscillation (first proposed by I. Cziegler following the hypothesis that it arises from a Kelvin-Helmholtz (K-H) instability [1]) radially localized to a region in between the spatial maxima of the fundamental was in fact observed, although without the spatial resolution necessary to substantiate the hypothesis a K-H origin;
3) evidence of a fluctuation at the QCM frequency was observed on Te by the FRC-ECE; this fluctuation was observed all the way into the center of the plasma column, with a phase relationship that has not yet been explained.
We wish to examine these issues further by changing the magnetic equilibrium from a LSN (with the B x grad B drift in the direction favorable for H-mode) to an USN configuration, which, although unfavorable for H-mode, is known for Ohmic L-mode plasmas to have an opposite poloidal plasma flow direction in the SOL [2]. We wish to test whether this change to USN will change the characteristics of the QCM.

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 experiment we require plasmas with robust and reproducible EDA H-mode period, similar to what we got in MP#442 (e.g. shots 1051202011-015). These shots achieved steady, long-lived EDA H-modes with strong QCMs that were observed by all of the QCM-sensitive diagnostics, including the FRC-ECE. The ICRF power in these EDA mode LSN discharges was 2.1 MW. These discharges also had a small (3 mm) outer gap. (We speculate that this small outer gap may be responsible for the appearance of the QCM harmonic.) In the unfavorable configuration proposed for this experiment, the H-mode threshold (power and edge temperature) is typically a factor of 2 higher than in LSN, so ICRF powers of ~4 MW are probably required. We will require a well-conditioned machine (i.e. soon after a boronization) and require at least two good shots at each of the following conditions in USN:

1) outer gap at 0.7 cm, i.e. sepx at R=89.8 cm. This puts the QCM at the location of the GPI's poloidal array of fiber views, and will allow determination of the spectral shape of \( k_{\text{pol}} \) at the outboard midplane.

2) sweep the outer gap in ~0.13 sec from 1.9 cm (R_sepx=88.6 cm) thru 0.7 cm (R_sepx=89.8 cm). This sweeps the QCM across the fast-diode views with the highest spatial resolution (1.7 mm). Although this was done in MP#442 (in LSN), detector noise near the harmonic frequency on the high resolution fast-diode views limited the usefulness of this sweep for localizing the harmonic oscillation. This noise problem will be eliminated for this experiment.

4. Resources

4.1 Machine and Plasma Parameters
Give values or range for:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toroidal Field</td>
<td>5.6 T (heterodyne ECE)</td>
</tr>
<tr>
<td>Plasma Current</td>
<td>(&lt; or = 0.8 \text{ MA}, \text{i.e. } q_{95}&gt;4)</td>
</tr>
<tr>
<td>Working Gas Species</td>
<td>D2</td>
</tr>
<tr>
<td>Density</td>
<td>(\text{NL}_04\sim1.0\text{e}20\text{m}^-2) for the RF target</td>
</tr>
<tr>
<td>Equilibrium configuration</td>
<td>USN</td>
</tr>
</tbody>
</table>

4.2 Auxiliary Systems
Run 1051202 - "Radial Structure and $k_{\theta}$ of QC Mode" $k_{\theta}$ from GPI poloidal array - $k_R$ from PCI
RF Power, pulse length, phasing: ~4MW for at least 0.5 s
Pellet Injection (species): no
Impurity blow-off injection: no
Diagnostic Neutral Beam: no
Special gas puffing: NINJA at A-B limiter for GPI
Non-axisymmetric Coils (Connections, Current);
Other:

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

Fast-diode outboard array with GPI
PCI with improved spatial resolution
FRC-ECE
Edge TS
HIREX core rotation measurements

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.

½ run day

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.

Establish plasmas with robust and reproducible EDA H-mode period. With that we would require two good shots at each of the following conditions:

1) 1st in LSN – with an outer gap at 0.7 cm, i.e. sepx at R=89.8 cm. This puts the QCM at the location of the GPI's poloidal array of fiber views, and will allow determination of the spectral shape of k_pol at the outboard midplane. ICRF power at 2 MW.

2) Switch to USN – with an outer gap at 0.7 cm, i.e. sepx at R=89.8 cm, again putting the QCM at the location of the GPI's poloidal array of fiber views. ICRF power at 4 MW.

3) Still in USN - sweep the outer gap in ~0.13 s from 1.9 cm (R_sepx=88.6 cm) thru 0.7 cm (R_sepx=89.8 cm). This sweeps the QCM across the fast-diode views with the highest spatial resolution (1.7 mm). ICRF power at 4 MW.

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.
In USN the characteristics of the QCM will be investigated with high spatial in the radial dimension with the GPI fast-diode views. High wavenumber resolution at the top and bottom of the plasma is available using the PCI. This experiment is another investigation of the physical characteristics of the QCM and should provide more valuable information as to its physics origin.

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