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 two important characteristics of the Quasi-Coherent Mode (QCM) with improved diagnostic capability.

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. And while initial BOUT simulations of the QCM showed a fluctuation with many of the observed QCM characteristics, the underlying physics of it have not been forthcoming from the simulation. Among the experimentally well-documented characteristics of the QCM are 1) it is radially localized to the H-mode pedestal region, and 2) it is approximately field-aligned, i.e. $k \cdot B = 0$, in which case $k_\theta$ varies on a flux surface as $k_\theta(\theta_1) = k_\theta(\theta_2) [B_\theta(\theta_2)/B_\theta(\theta_1)] (R_2/R_1)^2$.

The hypothesis that the QCM may arise from a Kelvin-Helmholtz (K-H) instability was proposed by Rogister, et al. in Ref. 1. Indeed they noted that neoclassical rotation and typical a pedestal density gradient would be such as to make the pedestal close to the onset of the K-H parallel velocity shear instability. One of us (I. Cziegler) has modeled the QCM as a Kelvin-Helmholtz instability in which case the radial profile and frequency spectra vs radius have distinct predicted signatures. That is, harmonics of the fundamental frequency ($\sim$100 kHz) should be present at the center of the radial profile of the mode. Such harmonics are occasionally seen with in the PCI spectra (see Fig. 1). We propose to
use the improved spatial resolution of the “fast-diode” outboard array to test this hypothesis.

Regarding point 2), the PCI has now improved its radial resolution so that “line-shape” of the QCM’s $k_\theta$ feature (typically peaked at ~5 cm$^{-1}$ at the top and bottom of the plasma) can be studied. Upgrades to the PCI now allow wavenumber resolution in the major radius direction to be 0.6 cm$^{-1}$, when used in the low-wavenumber detection setup. Of course, knowledge of the radial location and the magnetic equilibrium (from EFIT) allows the $k_R$ measured by the PCI to be converted to $k_\theta$. In addition, the wavenumber spectrum will be examined in a number a frequency bands spanning the frequency feature of the QCM. The “fast-diode” outboard array has also been upgraded with a poloidal array of fiber views, so that it too has the opportunity to study the QCM’s $k_\theta$ feature (typically peaked at ~1 cm$^{-1}$ at the outboard midplane) with higher resolution.

We propose the utilize these improved diagnostic capabilities to 1) test the K-H hypothesis and 2) resolve the $k_\theta$ feature at three different poloidal locations, top and bottom using the PCI and outside midplane using the poloidal array of the “fast-diode” outboard array.

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

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 may allow determination of the spectral shape of $k_{pol}$ 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) and tests the hypothesis that Kelvin-Helmholtz plays a role in the QCM’s origin.

4. Resources

4.1 Machine and Plasma Parameters

Give values or range for:

- Toroidal Field: 5.6 T (heterodyne ECE)
- Plasma Current: < or = 0.8 MA, i.e q_95>4
- Working Gas Species: D2
- Density: NL_04~1.0e20m-2 fpr the RF target
- Equilibrium configuration (if possible, refer to database equilibria): LSN
4.2 Auxiliary Systems

RF Power, pulse length, phasing: >2MW 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
Heterodyne ECE
Edge TS

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

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 may allow determination of the spectral shape of k_pol at the outboard midplane.

2) 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).

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.
Spatial characteristics of the QCM will be investigated with higher resolution than has been previously available - higher wavenumber resolution at the top and bottom of the plasma with the PCI and at the outboard midplane using the poloidal array of the 'fast-diode' system. The wavenumber spectrum as measured by the PCI will also be examined in a number a frequency bands spanning the frequency feature of the QCM. In addition, better radial resolution using the radial array of the 'fast-diode' system may allow a definitive test for a Kelvin-Helmholtz-like structure in the QCM. If observed, this would provide a valuable piece to understanding its physics origin.

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