1. Purpose of Experiments

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

Last year, 2 MA/8 T operation was attempted. (The run was for MP 328A, with the goal of testing the strengthened inner divertor/girdle, as well as achieving milestone 62.) However, the maximum current achieved was limited to 1.7 MA because of disruptions caused by locked modes. This led to the installation of the A-coil set and subsequent investigation of locked mode control in C-Mod. Based on these locked mode studies, we believe that we are ready to try again for 2 MA/8 T operation, using the A-coils to suppress locked modes.

2. Background

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

With the A-coils in a quadrupole configuration (+Dtop -Dbot -Jtop +Jbot), locked modes and disruptions have been reproducibly suppressed in 1 MA plasmas with +2 kA in the A-coils ($\langle n_e \rangle = 1.1 \times 10^{20} \, \text{m}^{-3}$, $B_\phi = 5.4 \, \text{T}$). We believe that the error field will increase with $B_\phi$ (linearly) and $I_p$, but the upgraded A-coil supplies can now output 3.5 kA. In addition, scalings from other tokamaks indicate that the error field threshold increases linearly with density. Therefore we should be able to use the A-coils to successfully achieve the plasma parameters specified in MP 328A.

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.

The plasma current, toroidal field, and A-coil current will be brought up in increments ($\Delta I_p = 0.2 \, \text{MA}$, keeping $q_{95}$ constant) while monitoring machine instrumentation (TF joints and OH coax resistances, girdle halo currents, alternator diagnostics), and locked mode indicators (ECE and x-ray sawteeth).
4. Resources

4.1 Machine and Plasma Parameters

Give values or range for:

Toroidal Field: up to 8 T
Plasma Current: up to 2 MA
Working gas species: $D_2$
Density: $\langle n_e \rangle = 2.0 \times 10^{20} \text{ m}^{-3}$

Equilibrium configuration (if possible, refer to database equilibria): start with a 1 MA, 5.4 T discharge (?)

Pulse length, typical current & density waveforms, etc. Refer to database or sketch desired waveforms.
Standard

4.2 Auxiliary Systems

RF Power, pulse length, phasing: not required, but could try He$^3$
Pellet Injection (species): no!
Impurity blow-off injection: no!
Diagnostic Neutral Beam: if available

Special gas puffing: None to start with (maybe turn on argon, depending on how well the run goes)
Other: A-coils in the quadrupole configuration (+Dtop -Dbot -Jtop +Jbot)

4.3 Diagnostics

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

All machine instrumentation, but most importantly TC and TF scanners, OH coax instrumentation, halo diagnostics. ECE and core x-ray for sawtooth monitoring.
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.

One run day is required with no special requirements.

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 contin-
gency plans, if appropriate.

- On all disruptions we will monitor the $I_h B_t$ product and observe the WARNING,
  STRIKE, and OUT.
  - Warning level: 1500 kA-T
  - Strike level: 2500 kA-T
  - Out level: 3500 kA-T
- Begin operation at 1.0 MA and 5.4 T (?) Verify that instrumentation is operational.
  Develop reliable rampdown at this current level. Two discharges in a row should be
  produced that extend well into rampdown before the current is increased.
- Increase $I_p$ in 0.2 MA steps while increasing $B_t$ to maintain $q_{95}$, and A-coil current to
  maintain stability. Carefully monitor TF tap, OH coax, thermocouple, halo current,
  and locked mode data as we move up in current.
- Take two shots at each condition as $I_p$ is raised.
- Puff He$^3$ as required for heating experiments?
- Approximately 20 shots for base plan, plus whatever is needed for heating experiments,
  if we decide to do them.

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.

We will show that Alcator C-Mod can operate at new high levels of performance. Milestone
62 will have been accomplished.

Note that a 1.9 MA, 8 T discharge is also needed for part of the proposed C-Mod/JET
locked mode experiments (although with a different A-coil configuration, and at higher
density).

7. References

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

Mini-proposals 076 and 156a, and proposed MP on C-Mod/JET locked mode experiments