Subject: Evaluation of edge MHD stability based on CXRS and MSE data and access to type I ELMy regime on C-Mod

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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 the experiment is to obtain new data for reevaluation of H-mode pedestal stability with known edge current and ion temperature profiles.

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

MHD stability of EDA and ELMing discharges on C-Mod was analyzed with ELITE ideal MHD code using pedestal electron temperature and density profiles measured by edge Thomson scattering diagnostic [1]. The results are in general agreement with coupled peeling/ballooning model for ELMs, suggesting that EDA QC mode is a resistive MHD mode, since ideal modes were found stable in EDA discharges. However, to analyze the experimental data with ELITE several important assumptions had to be made. Namely, we had to assume that ion temperature equals electron temperature in the pedestal region and we had to use bootstrap current profile calculated using a neoclassical model. These uncertainties in current profile and ion temperature led to discrepancies between calculated and observed stability boundary for small ELMs, especially in the low pedestal collisionality region.

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.
CXRS and MSE diagnostics that will be available on C-Mod during 2004 run campaign will provide for the first time accurate measurements of pedestal ion temperature and current. The results of these measurements can be used to reevaluate stability calculations done with ELITE code. In addition, the new data can be used as input to KINX ideal stability code that evaluates stability of external kink modes including stabilizing effects of the separatrix. The CXRS diagnostic will provide the ion temperature profile in the pedestal region with sufficient resolution. The expected resolution of MSE measurements will not be enough to reconstruct the current profile at the edge, but should be sufficient to carry out a normalization of the modeled current profile to measured integral value of edge current.

It is proposed to collect pedestal data in various H-mode regimes (EDA and ELMing) for a wide range of pedestal parameters (density and temperature) and use this data to model the stability boundary for ideal modes that can be then compared with the observed operational range for EDA and ELMs in the n_e – T_e space. Effects of plasma shape on modes stability should be studies as well. Large part of the proposal can be run as “piggyback” on an existing miniproposal on mapping operational boundaries for EDA and ELMs on C-Mod (MP#304) providing that MSE and CXRS diagnostics are operational.

4. Resources

4.1 Machine and Plasma Parameters

Give values or range for:

- Toroidal Field: 5.4 T
- Plasma Current: 0.6 – 1.2 MA
- Working Gas Species: 
- Density: L-mode target n_l 5e19 – 2e20
- Equilibrium configuration (if possible, refer to database equilibria): separate upper and lower triangularity scans over the whole operational range.

4.2 Auxiliary Systems

- RF Power, pulse length, phasing: 0.6 sec min, power up to 6 MW
- Pellet Injection (species): 
- Impurity blow-off injection: 
- Diagnostic Neutral Beam: MSE, CXRS
- Special gas puffing: 
- Other: 

4.3 Diagnostics

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

- Edge and core TS, ECE (with Bt sweeps), MSE, CXRS, scanning probes
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.

1 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.

During each shot three levels of ICRF power will be used, each 0.2 sec long. First level should be programmed to be sufficient to obtain a steady EDA H-mode, second level will be adjusted to achieve pedestal temperature at the upper boundary of EDA regime (~ 500 eV) and then the RF power should be set at the highest level possible (6MW ?). Then plasma current and target density will be varied shot to shot:
\[ I_p = 0.6, 0.9, 1.2 \text{ MA} \]
\[ n_l(\text{target}) = 0.5 \times 10^20, 1 \times 10^20, 2 \times 10^20 \]
similar to MP 304
If the scan is accomplished, the triangularity scan should be carried out at a maximum level of power using current and density that provide access to ELMing regime to evaluate dependence of ELMs stability on plasma shape.

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.

As a result of the proposed scans we should collect sufficient amount of data to evaluate ideal MHD stability boundary over the entire operational range of H-mode regimes.

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