1. Purpose of Experiments

The purpose of this experiment is to obtain a complete set of edge profiles with all available diagnostics over a range of conditions. A rigorous consistency check will then be carried out between overlapping diagnostics.

2. Background

The edge diagnostic complement on C-Mod has now increased to the point where there are many overlapping diagnostics, both in parameter measured and in spatial location. It is now time to look for consistencies between different diagnostics. For example, a preliminary comparison between the helium beam and fast scanning probe revealed profiles that had similar absolute values and shape, but appeared to be radially shifted by 6 mm. Is this mechanical error or interpretational error? The addition of the mid-plane probe, more helium beam channels, Edge Thomson, etc, will hopefully clarify.

In addition to mechanical errors, there are many other reasons why one may find differences between these supposedly overlapping diagnostics. For example, some diagnostics look at different parts of the electron distribution, i.e. tails as opposed to bulk electrons. Distributions may not be Maxwellian. Density may play a key role in this, and thus a main parameter to vary is discharge density.

Further, certain diagnostics are a convolution of not just \( n_e \) and \( T_e \), but also impurity concentrations, e.g. X-rays and bremsstrahlung. The greater accuracy in our \( n_e \) and \( T_e \) profiles will hopefully ease the interpretation of these less direct diagnostics.

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.
We will try to obtain detailed profiles under the following conditions, Ohmic, L-mode, EDA and ELM-free. It may be necessary to make special provisions for ECE edge profiles (small B scan). In addition, it may be desirable to scan the plasma-wall gaps slightly to effectively increase the number of spatial channels of a number of other diagnostics (Edge Thomson, helium beam, edge XUV). In Ohmic and L-mode discharge phases, we may add a small amount of neon gas to increase the edge emissivity for certain diagnostics.

4. Resources

4.1 Machine and Plasma Parameters

Give values or range for:

Toroidal Field: 5.3 T
Plasma Current: 0.8 MA
Working gas species: \(D_2\)
Density: Target density range, \(n_{04} = 0.6\) to \(n_{04} = 1.6\).
Equilibrium configuration (if possible, refer to database equilibria): SNL

Pulse length, typical current & density waveforms, etc. Refer to database or sketch desired waveforms: standard fiducial will be acceptable perhaps with some modification of the separatrix strike point locations.

4.2 Auxiliary Systems

RF Power, pulse length, phasing: 2 MW
Pellet Injection (species): No
Impurity blow-off injection: No
Special gas puffing: Neon.
Other:

4.3 Diagnostics

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

Edge profiles from, ECE, Kaiser (helium beam), FSP, ASP, Edge Thomson, reflectometer, X-ray arrays, bolometers, Z meter array, tangential interferometer.

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.)
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.

This experiment requires roughly half a run day. This would be preferably near the beginning of the physics campaign, so that these results could be accounted for in future experiments.

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.

We will attempt to have two ‘flat-tops’ per discharge, the first Ohmic (300 ms duration), the second ICRH heated (300 ms duration).

(1) 4 discharges, target density n04 = 1.0, 2 MW (Ohmic, EDA).
(2) 4 discharges, target density n04 = 0.6, 2 MW (Ohmic, ELM-free).
(3) 4 discharges, target density n04 = 1.6, 2 MW (Ohmic detached, L-mode).

Depending on our success, some shots will have neon added to bring up the edge emissivity.

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 anticipate that there will be good qualitative agreement between overlapping diagnostics, although we suspect quantitative disagreement in profile shape, position and absolute values. The experiment should allow us to make corrections where needed and interpret future pedestal and edge data with more confidence.

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