Subject: Optimize the gate timing for the Thomson scattering data acquisition system

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Group: Diagnostics

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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 these experiments is to characterize the optimal gate timing for the Thomson scattering data acquisition system using the start-up phase plasmas.

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

Getting the gate timing of the data acquisition system correct is critical to ensure the TS measurements of $T_e$ and $n_e$ are accurate. Recently it has been found that the gate duration was not optimized for some spectral channels to capture the scattered laser light pulses exactly (Fig.1). It is of high priority to make this deficiency remedied. However previous attempts using gas Raman scattering has the limitation that the scattered light is monochromatic, therefore they cannot be detected by all spectral channels. This obstacle can be avoided in a plasma discharge from which the scattered lights can yield detectable signals in all the four spectral channels of the spectrometers (or at least three if the electron temperature is lower).

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.

Identical target discharge (Ohmic, $B_t=6.5T, I_p=1.2MA, n_{t04}=0.6x1e20$) will be repeated during the run. The integrating time of TS data acquisition system will be adjusted between shots. A span of 300ns will be scanned to cover the temporal response regime of the spectrometers to YAG lasers pulses. The machine conditioning phase is appropriate for this MP to be executed.
4. Resources
4.1 Machine and Plasma Parameters

Give values or range for:

Toroidal Field: 6.5T
Plasma Current: 1.2MA
Working Gas Species: D₂
Density: n̅l04=0.6x1e20
Boronization Requested (if yes, specify whether overnight or between-shot, how recently needed, and any special conditions.): no
Equilibrium configuration (if possible, refer to database equilibria): Std. equilibrium, kappa~1.7

4.2 Auxiliary Systems

ICRF Power, pulse length, phasing: no
LHCD Power, pulse length, phasing: no
Pellet Injection (species): no
Impurity blow-off injection: no
Diagnostic Neutral Beam: no
Special gas puffing: no
Cryopump: If available, for density control
Non-axisymmetric Coils (Connections, Current): Std. error correction config.
Other:
4.3 Diagnostics
List required diagnostics, and any special setup or configuration, e.g. non-standard digitization rate.
Thomson scattering (with gate timing varied shot to shot), ECE, TCI

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 is requested. 30~40 discharges are required.

Starting from the current setup at 190ns, decrease the gate timing by 20ns after each shot till 10ns. Then set the gate at 200ns and decrease the timing by 20ns each shot till 20ns. Evaluate the results after the two steps above are accomplished. If finer resolution is required, then decide where more points need to be filled in between the scanned gate durations. It is estimated that finer scans if necessary will be taken in between [130,180] ns and [50,100] ns. The total number of shots required for finer scan is about 10~15.

When the resolution is considered to be adequate then set the gate at 210ns and increase the timing by 10ns after each shot till 250ns.

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.

Starting from the target discharge: Ohmic,Bt=6.5T,Ip=1.2MA,nl04=0.6x1e20. If the plasma is steady and Te is high as desired then repeat this target shot while making the gate timing scan. Otherwise adjust the programmed target parameters till the target discharge is suitable and then proceed with the timing scan.

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, an ITER request, or an external database.

The time response curve of each spectral channel to the laser pulses and of YAG energy measurements will be obtained. Correct timing for the new TS data acquisition system will be configured. This MP may be run as needed after major TS configuration changes that might occur in the future, such as the replacement of timing hardware, optical fibers or signal cables.

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

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