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SUBJECT: IMPACT OF POTENTIAL POLAR REGION MODIFICATIONS ON RESEARCH AND SCENARIOS FOR TSG-PED

The TSG-PED has identified key requirements to insure productive pedestal experiments on NSTX-U. The parameters not mentioned here are not strict requirements for anticipated pedestal experiments.

Summary:

1. The group would like to have 1.5 -2 s flattop discharges. The flattop length is dictated by the anticipated increase in energy confinement time of 100ms and the low temporal resolution of the Thomson scattering (TS) system (60 -90 Hz). It is worth noting that we anticipate an ELM frequency ranging from 5Hz to 75 Hz depending on the wall coating. With such frequencies, in order to resolve the inter-ELM dynamics using TS and minimize the repeat shots, it will be necessary to aim for 1.5 – 2 s of discharge lengths.
2. Experiments overall will need the full triangularity range capability (0.3-0.7). In addition, for physics study of the pedestal dynamics, we ought to keep the pedestal fuelling constant. This is achieved by keeping the triangularity fix for at least over the 1.5s flattop. We are open to sweep the strike point in over 1.5 s flattop. Furthermore, we do not require fixed kappa during our triangularity scans.
3. The full magnetic field strength is also required for I- and H-mode experiments
4. Anticipated experiments require a mix of magnetic geometries. In particular, I-mode experiments require USN configuration, and LGI and Li wall conditioning experiments may require DN configuration.

Derivation of flattop duration:

- 60 Hz Thomson scattering system
- Typical type I ELM frequencies
    - Low lithium (~50 mg) wall conditioning: ~ 10 Hz @ 1.2 MA
    - Boronized disharges: 50 – 125 Hz (From R. Maingi)

With Ip= 2MA, we expect the ELM frequency to decrease by ~1/2 from the assumption above. Therefore the expected ELM frequency would be 5 – 75 Hz including scenarios using lithium wall coating.
At 5 Hz ELM frequency, we are confident that we can resolve the inter-ELM dynamics fairly well with a flattop of 500 ms or more.

At 75 Hz, the inter-ELM time (13 ms) is similar to the time between TS points of ~ 16 ms. So we will be **relying** on statistical jitter inter-ELM times of few ms to generate composite profiles to capture the inter-ELM dynamics of the pedestal with resolution of 1 ms. This necessary temporal resolution is guided by experiments on D3D where the pedestal recovery time for density gradient was found to be between 3 -5 ms.

Note that the burst laser system can in principle catch almost 4 inter-ELM intervals if 75 Hz is assumed. The burst temporal resolution is assumed to be 1 ms. I would like to avoid relying on this aspect of this new system for now as it has not been fully commissioning. Adding the 30 Hz option from PBLS will reduce the constraint of getting up 2 s flattop.

To sum up, our choice for 1.5-2 s is solely dictated by the available rep rates of the TS system and the need to improve our statistics. One can conceivably allow for repeat discharges to cover most of the inter-ELM times needed, as may be required for acceptable heat flux at low triangularities and low flux expansion with high Ip and heating power. The results will be more uncertain.

Distribution

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NSTX-U File