Daily Report for 2025-11-13

C. Suzuki

Date: November 13, 2025
Time: 9:45 – 18:45
Shot: 196735 – 196905 (171 shots)
Prior wall conditioning: H_2 GD
Divertor pump: Yes
Gas puff: H_2
Pellet: Fueling

NBI: #1, #2, #3, #4, #5
ECH: 5.5-UO (77GHz), 2-OUR (77GHz), 2-OLL (154GHz), 2-OUL (154GHz)
ICH: No injection

Topics

1. Study on core density peaking and flattening in plasmas (Masaki Nishiura)
2. Investigate turbulent heat transport inside density peaking and flattening plasmas (Mingzheng Gong (U. Tokyo), Masaki Nishiura)
3. Model predictive density profile control with pellet fueling (Christopher Anthony Orrico (DIFFER), Naoki Kenmochi)
4. Digital TwinBased Advanced Control of LHD Plasma by ASTI (Yuya Morishita (Kyoto U.), Naoki Kenmochi)
5. Investigation of local and nonlocal turbulence during thermal pulse propagation by MECH injection (Naoki Kenmochi)

C. Orrico

Development of model predictive density profile control with pellets and gas

Experimental conditions:

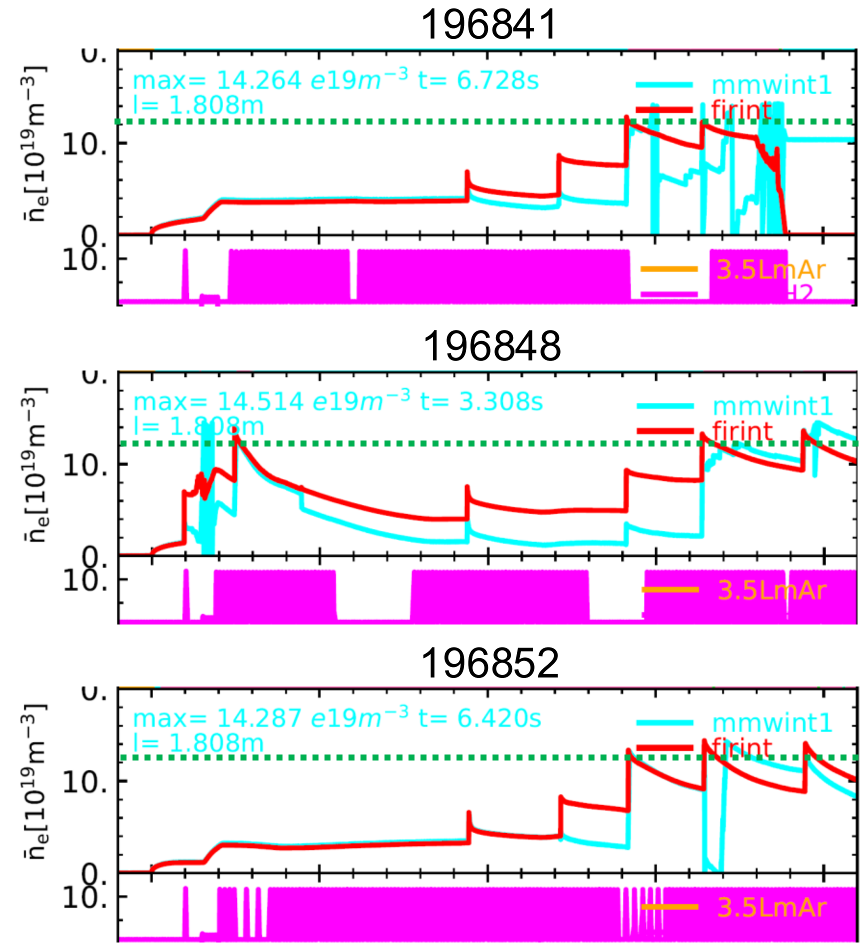
(R_{ax}, Polarity, B_t, γ, B_q) = (3.6. m, CW, 2.75 T, 1.2538, 100.0%)
#196833-196852

Motivation and method:

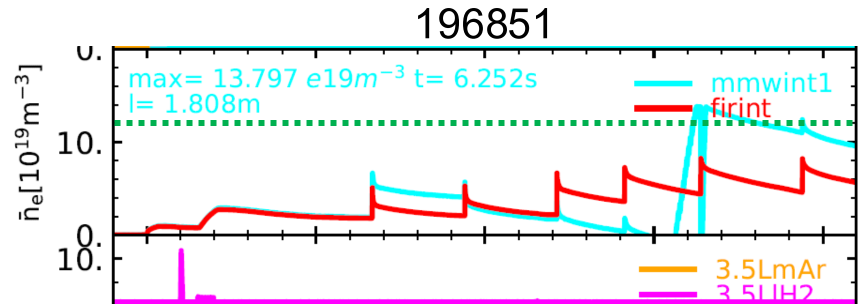
- ➢ Test of feedback model predictive control of density profile using gas with feedforward optimized pellet timings (196833-196847, 196851, 196852
- ➢ In preparation for the experiment on Dec. 2nd, non-integer frequency MECH was tested in discharges #196849 (2OLL 35ms on/off) and (#196850 5.5Uo, 45ms on/off).

Results:

- ➢ 4 ok control discharges (right) show feedback control improvement over feedforward only
- ➢ Struggle with wall conditions, pellet injector conditions
- ➢ Can make improvements to controller for next experiments



Feedforward Pellets
Gas Feedback



Feedforward
Only

Study on core density peaking and flattening in plasmas

M. Nishiura, R. Yanai, M. Yoshinuma, and T. Ido

Experimental conditions:

(R_{ax}, Polarity, B_t, γ, B_q) = (3.75 m, CW, 1.375 T, 1.2538, 100.0%) #196733 - #196772

(3.6 m, CW, 2.75 T, 1.2538, 100.0%) #196773 - #196805

Motivation and method:

- Particle transport in plasmas has been observed to be regulated by controlling the velocity-space distribution of energetic ions. Changes in the particle transport state are consequently reflected in the plasma density profile. Previous studies have demonstrated that
  - inward and outward reversals of particle transport can be induced, and
  - transitions among hollowed, peaked, and flattened density profiles can be controlled within a single discharge even without pellet injection.

  However, the underlying mechanism responsible for these transitions remains unclear.

Results:

- Density peaking and flattening occurs in the case of low field and outward shifted configuration(see Fig. 1)
- Modulated ECH with on-axis and off-axis is applied to analyze the effect of radial electric field on particle transport. For the neoclassical analysis, HIBP measures the plasma potential profiles.

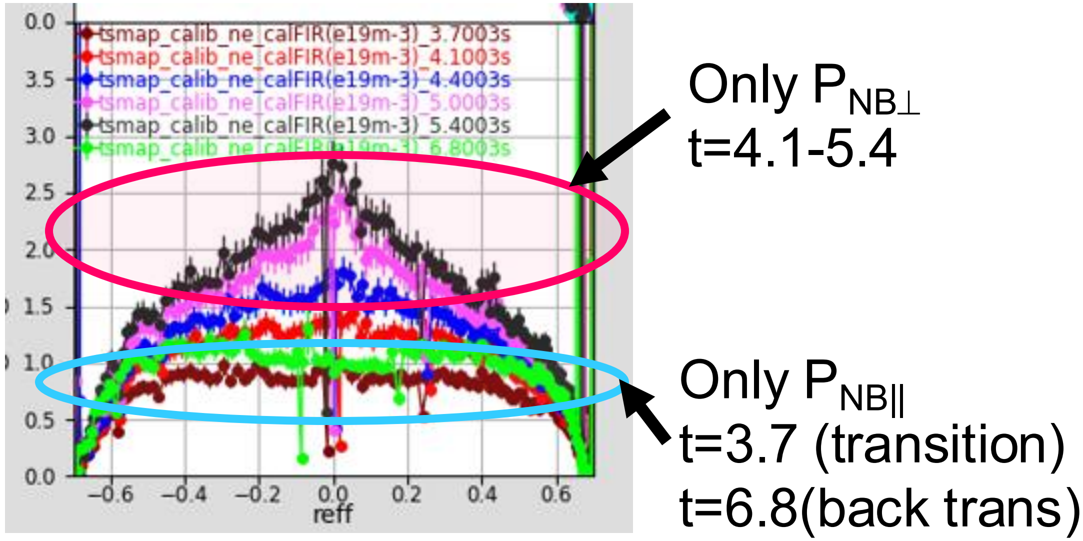


Fig. 1. #196766

Rax=3.75m, Bt=1.375T

Investigate turbulent heat transport inside density peaking and flattening plasmas

M. Gong, M. Nishiura, R. Yanai, and K. Ueda

Experimental conditions:

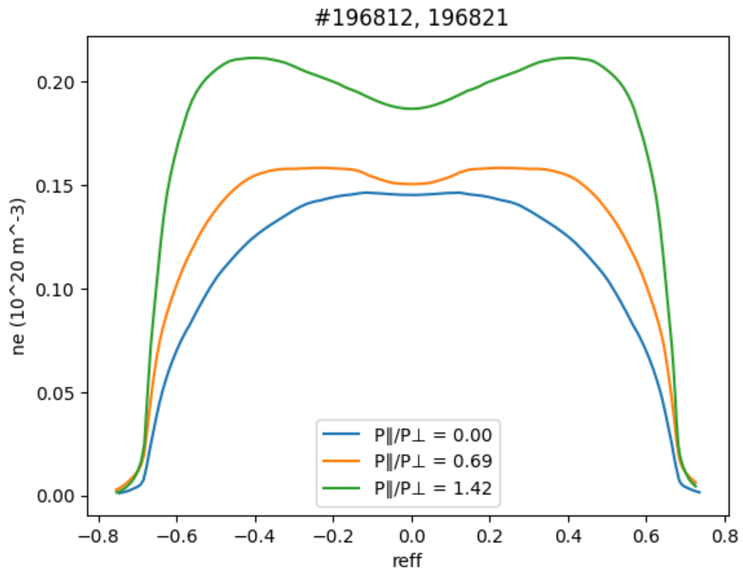
(R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CW, 2.75 T, 1.2538, 100.0%)
#196806 - #196829

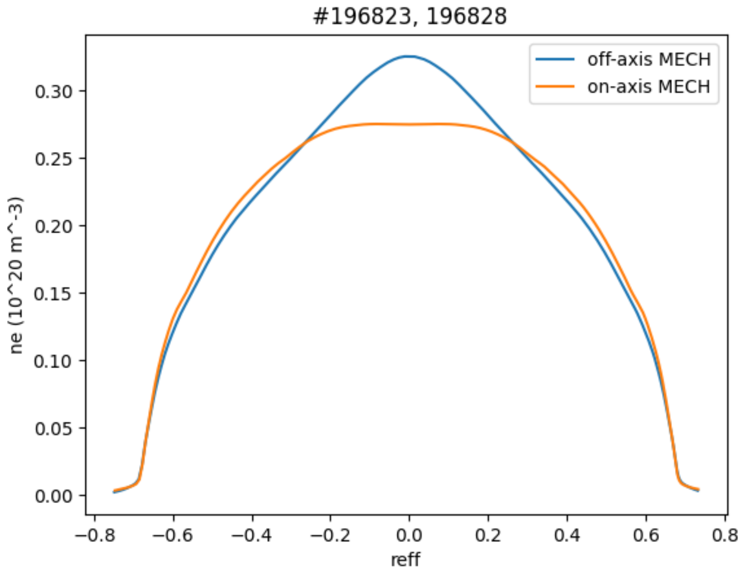
Motivation and method:

- Electron density profile can be controlled by changing energetic ion anisotropy.
- Previous experiments show similar Te profiles for density peaking and flattening plasma.
- Using MECH to study the heat transport features in different density profile plasma.

Results:

- With on-axis MECH, density profile evolves from slightly peaked to hollow as the NBI power ratio $P\|/P\perp$ increases.
- Density profile transform to strongly peaking with off-axis MECH.





Digital Twin-Based Advanced Control of LHD Plasma by ASTI (Y. Morishita, N. Kenmochi)

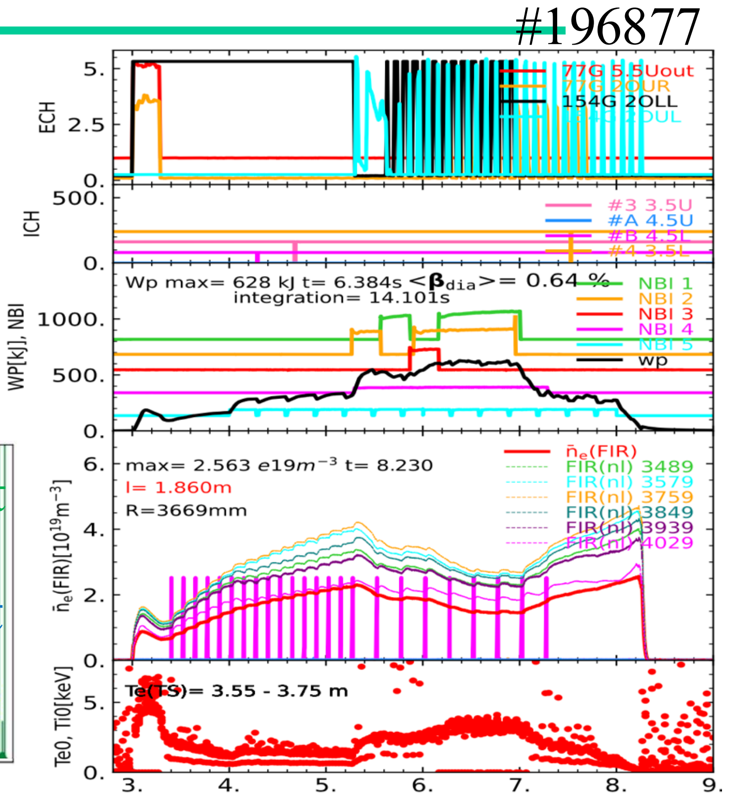
Shot #: 196753-19778

Experimental conditions:

(R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CW, 2.75 T, 1.254, 100 %)

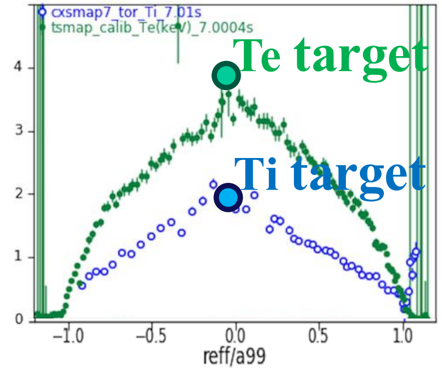
Motivation and objective:

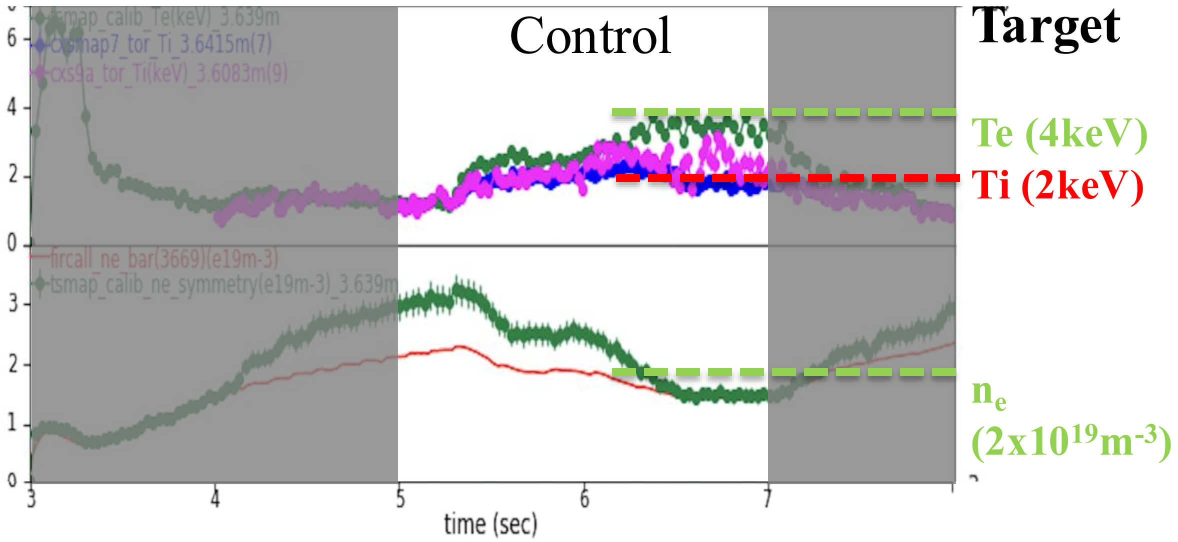
To demonstrate the real-time plasma control using the data assimilation-based control system (ASTI) running at the new Plasma Simulator, located at the Rokkasho site.



Results:

- We used up to 10,000 cores of the Plasma Simulator.
- For the first time, we conducted control experiments using all available actuators: ECH (#1, 2, 4, 5), NBI (#1–4), and pulsed gas puff, to control the electron density, electron temperature, and ion temperature.
- In several discharges, we successfully demonstrated the control. The figure shows an example of the control results.
- For the density control, an error of approximately 20% remains. This is likely due to the discrete nature of the pulsed gas-puff frequency. Improving the control accuracy is expected by shortening the pulse width and increasing the frequency resolution.
- In the next experiment (Nov. 21), we plan to refine the actuators and the model to achieve higher-precision control.





Investigation of local and non-local turbulence during thermal pulse propagation by MECH injection

N. Kenmochi

Experimental conditions:

(R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CW, 2.75 T, 1.2538, 100.0%)
#196714 - #196732

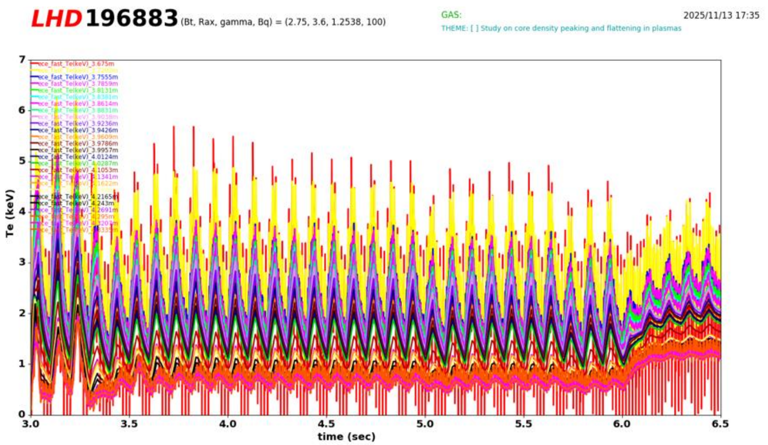
Δt_{ECH}=40 ms

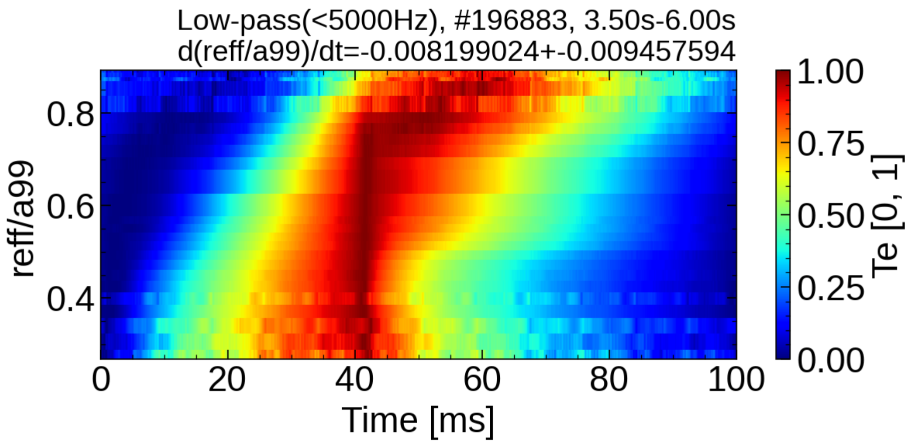
Motivation and method:

- ➢ Investigate the characteristics of non-local turbulence revealed in the previous cycle by conducting more detailed turbulence measurements.

Results:

- ✓ Heat and turbulence propagations were observed.
- ✓ Positional scan data of BS and HIBP measurements have been successfully taken.
- ✓ Based on the results of temperature and turbulence measurements, the mechanism of local/non-local transport will be investigated.





electron-scale tuerbulence