Daily Report for 2025-11-21

G. Motojima, M. Goto

Date: November 21, 2025
Time: 9:30 – 18:45
Shot: 197543 – 197713 (171 shots)
Prior wall conditioning: No
Divertor pump: Yes
Gas puff: Yes
Pellet: TESPEL*, IPD

NBI: #1, #2*, #3, #4, #5
ECH: 2-OUR (77GHz), 5.5-UO (77GHz), 2-OLL (154GHz)
2-OUL (154GHz)
ICH: Yes

- ✓ ***Vacuum leak in TESPEL injector**
  Impact on No.3 exp.
- ✓ ***After shot #197648 (15:15), false "low gas-feed pressure" and "gas-leak detected" alarms were triggered on NBI#2. The alarms could not be reset but were identified as false alarms originating from the main unit room, so they were locked out and conditioning operation resumed at 16:45.**
  Impact on No. 5 exp.

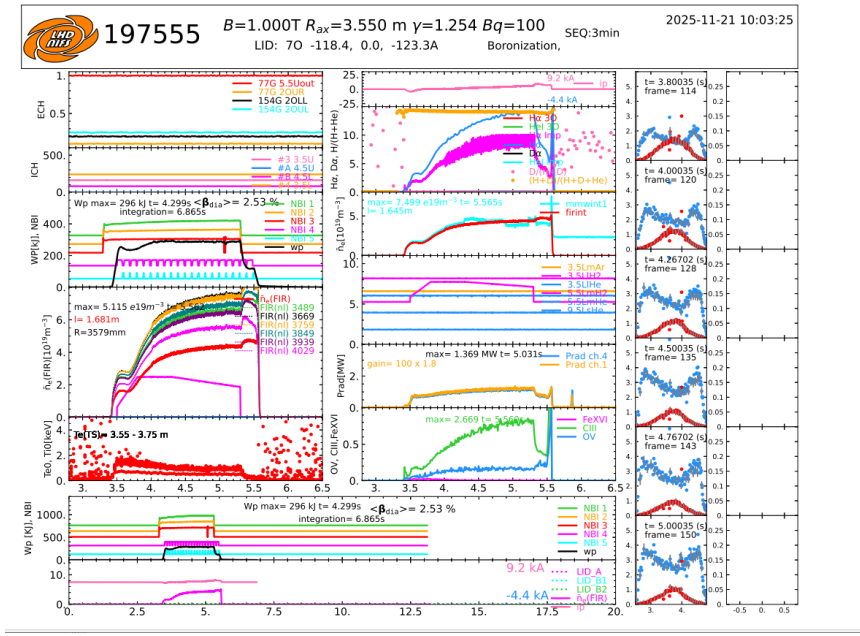
Topics

1. multi-scale turbulence response in spontaneous phenomena (T. Tokuzawa)
2. Impurity effect on turbulent transport in magnetically-confined toroidal plasmas (N. Tamura (IPP)+)
3. Impact of powder injection on impurity transport (D. Medina Roque, K. J. McCarthy (CIEMAT)+)
4. Remote control of LHD plasma using the new Plasma Simulator (Y. Morishita (Kyoto Univ.), N. Kenmochi)
5. Direct interaction between fast ions and turbulence (Sakai (QST), K. Tanaka)
6. Dependence of minority ion heating efficiency on resonance layer and antenna (R. Seki)

multi-scale turbulence response in spontaneous phenomena

T. Tokuzawa

Experimental conditions: #197545 - #197591
(R_{ax}, Polarity, B_t, γ, B_q) = (3.55 m, CW, 1.0 T, 1.2538, 100.0%),

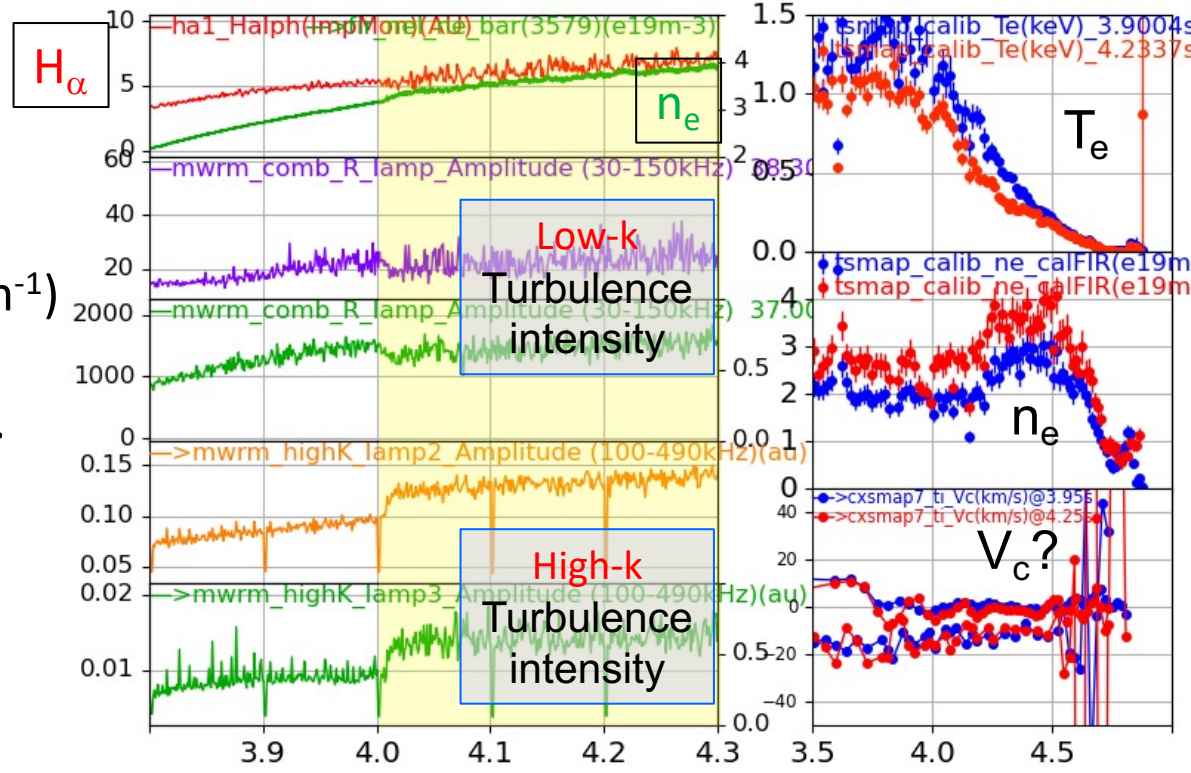


Motivation and method:

- How do turbulent components with different wave numbers respond when abrupt phenomena occur?
- Utilizing the L-H transition as a spontaneous phenomenon, we simultaneously measure turbulence of various wave numbers at the same location.

Results:

- We succeeded in reproducing so-called L-H transition.
- Previously, we observed only one wavenumber(k ~ 30 cm^{-1}) in high-k measurement, but this time we were able to observe several different wavenumbers (k ~ 25 - 50cm^{-1}).
- This time as well, turbulence decreased at low wave numbers (~ ion scale turbulence) and increased at high wave numbers. We will organize whether the response differs depending on the wavenumber.



Impurity effect on turbulent transport in magnetically-confined toroidal plasmas (N. Tamura, K. Mukai, T. Tokuzawa, M. Goto, T. Kobayashi, T. Nishizawa)

Magnetic configuration: (R_{ax}, Polarity, B_t, γ, B_q) = (3.60 m, CW, 2.750 T, 1.2538, 100.0%)
Shots: #197592 - #197064 (13 shots)

Goal of this experiment

- In this study, we systematically investigate how the spatio-temporal structure of electron density fluctuations in high-temperature toroidal plasmas changes with time when impurity ion profiles different from those of background ions and electrons are formed by impurity injection into the high-temperature toroidal plasma

Background & Motivation

- The improvement in confinement caused by introducing impurities is thought to be due to the reduction of turbulent transport triggered by the impurities.
- Still, the intrinsic role of impurities in reducing turbulent transport remains largely unexplained experimentally, although theoretical and simulation studies have pointed out their effects (e.g., impurity mode).

Approach & Methodlogy

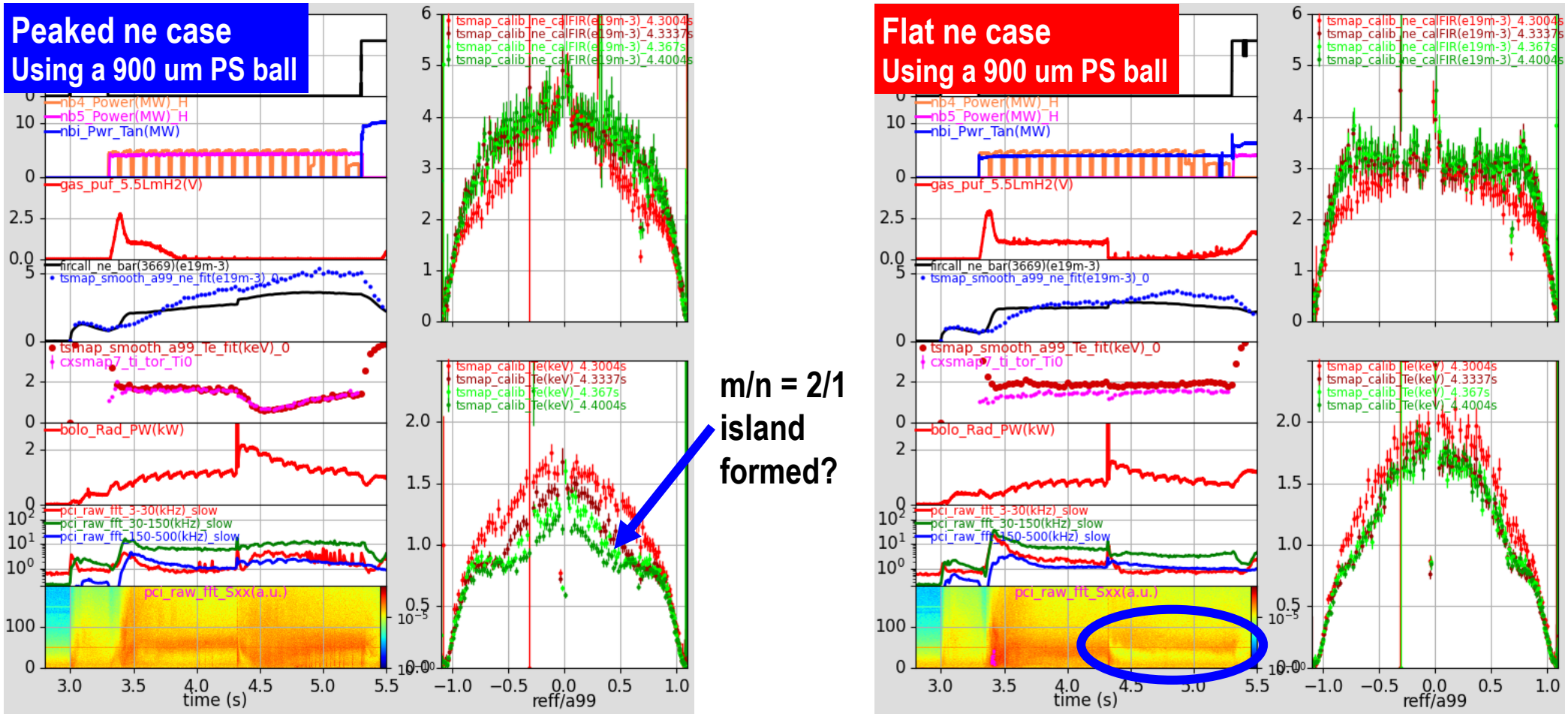
- Inject the same amount of Fe impurities into plasmas with a) peaked density profile, b) flat/hollow density profile
  - ✓ Fe-TESPEL (600um shell, 900um ball): Aim to make different deposition profile of Fe impurity
  - ✓ Fe impurity pellet (Φ0.8 mm x 0.5 mm): as a reference

Impurity effect on turbulent transport in magnetically-confined toroidal plasmas

(N. Tamura, K. Mukai, T. Tokuzawa, M. Goto, T. Kobayashi, T. Nishizawa)

Results

- We have successfully injected Fe-TESPEL using a 600 um PS shell and a 900 um PS ball into the plasmas with peaked and flat density profiles (**Note: injected Fe particle numbers are the same**)
- **Density fluctuations** (measured with PCI) **after the TESPEL injection have changed in the flat density profile**
- Other tubulence diagnostic data (e.g., DR, BS) will also be analyzed



Impact of powder injection on impurity transport

(D. Medina Roque, N. Tamura, I. García Cortés, K. J. McCarthy, et al.)

Experimental conditions:

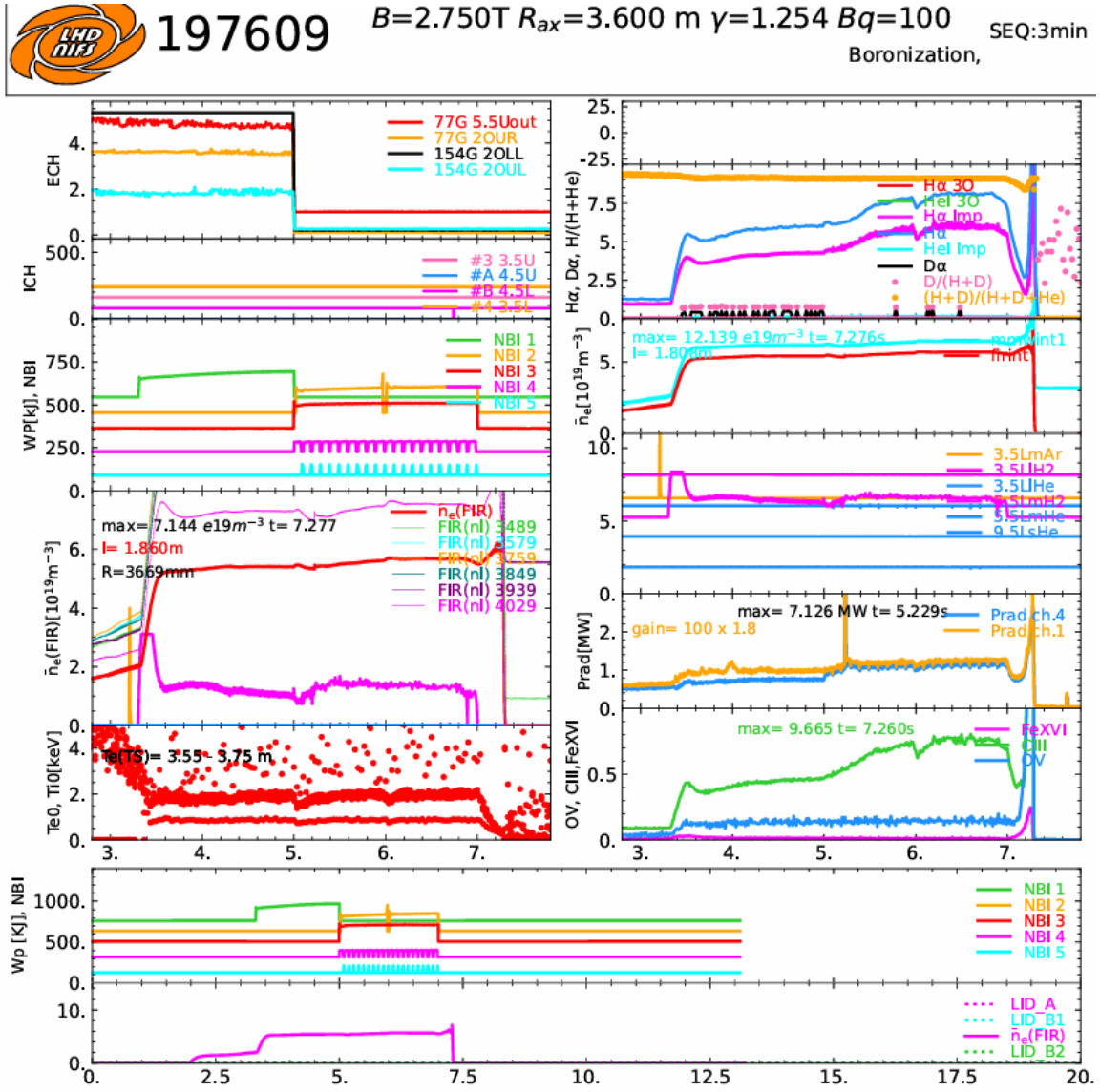
(R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CCW, 2.75 T, 1.254, 100.0%)
Heating: ECH#1,2,4,5,7 (3s - 5s), NB#1 (3.3s-5s)(t), NB#2,3 (5s-7s)(t), NB#4(5s-7s)(p)(80 on/20 off), NB#5(5s-7s)(p)(20 on/80 off),
Shots: #197605 – #197625

Motivation and method:

- Study the impact of IPD powder drop rate (Li) on mid/high Z tracer confinement using TESPEL method
- Previous studies revealed an unexpected reduction in confinement time when Li granule dropping made.

Results:

- Successful Ti-TESPEL injections with/without IPD at 1.5 V and 3 V for Li.
- Failed Ti-TESPEL injection with IPD at 4.5 V after #197617. Vacuum leak problem identified with TESPEL gate valve.
- Ended experiment early.



Remote control of LHD plasma using the new Plasma Simulator (Y. Morishita, N. Kenmochi)

Shot #: 196733-19755

Experimental conditions:

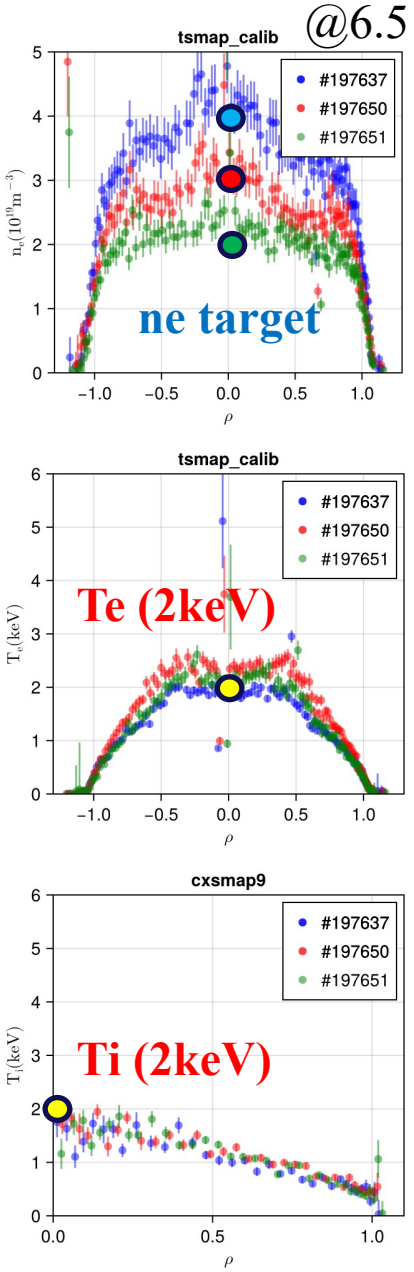
(R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CW, 2.75 T, 1.254, 100 %)

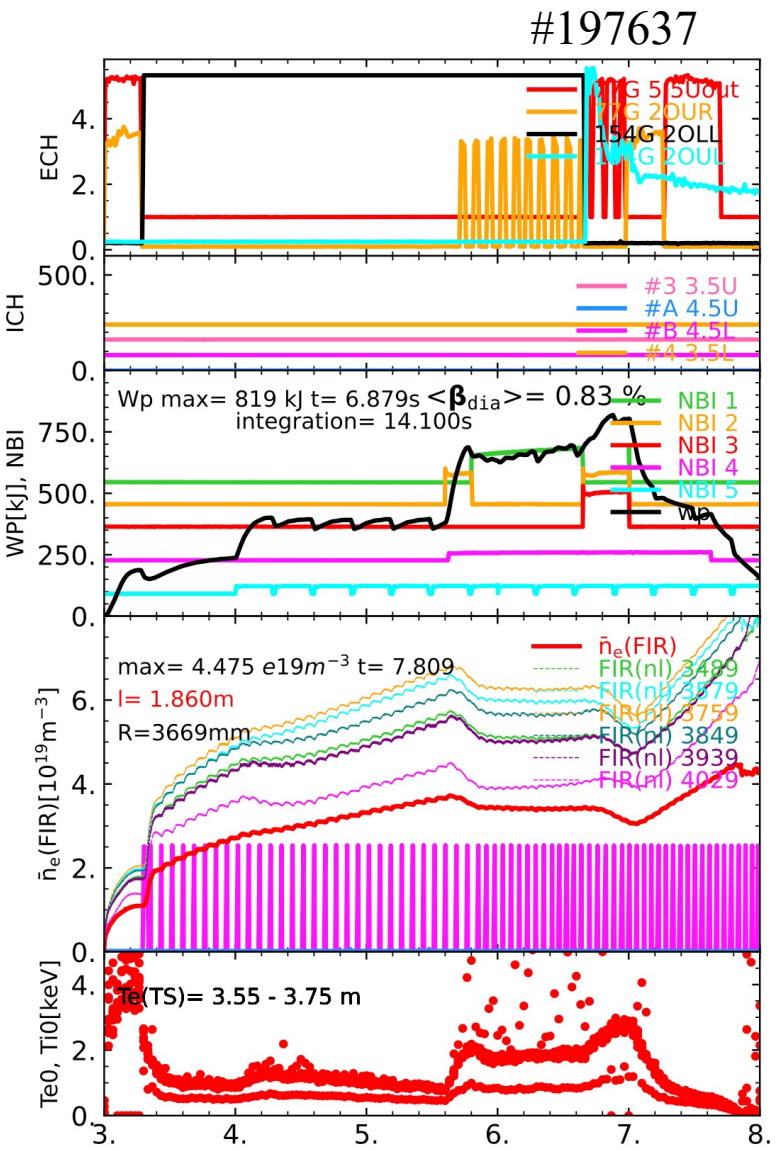
Motivation and objective:

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:

- In the previous experiment, the computation time limited us to using up to 10,000 cores on Plasma Simulator. In this experiment, it has become possible to utilize 20,000 cores.
- 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 figures show representative examples of the results. In these experiments, the target density was varied, while the target values for Te and Ti were kept fixed.
- Centrally peaked density profiles were often observed, but the current predictive simulations cannot reproduce them. For the next experiment, we try to develop a model that incorporates this phenomenon and attempt to control the radial density profile.





Investigation of direct interaction between fast-ion and turbulence

H. Sakai (QST), T. Nakayama (Tottori-Univ.)

Experimental conditions:

(R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CW, 2.75 T, 1.2538, 100.0%)
#197658 – #197673

!! NB#2 couldn't be completely injected due to machine trouble
!! ECH#5 couldn't be partially injected due to Luminescence of Mo plate

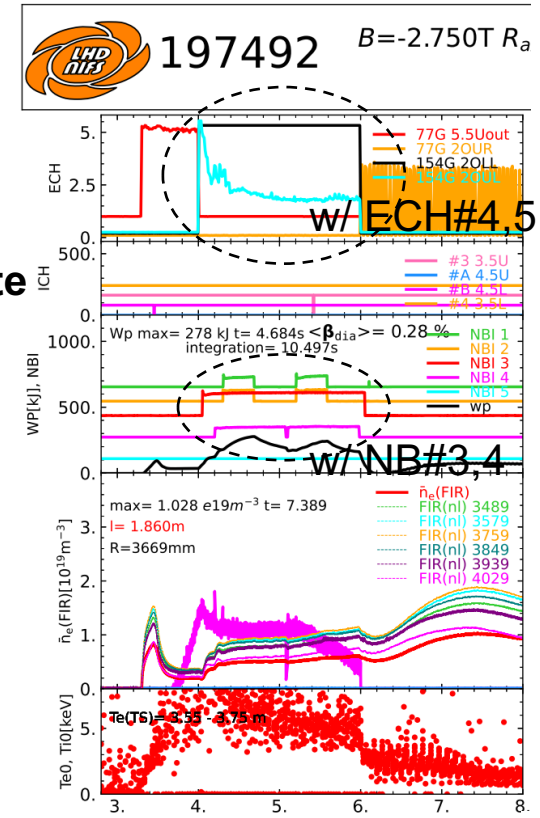
Motivation and condition:

- Investigating the effects of fast ions on turbulence to compare CCW exp.
- NBI modulation, Power scan, Pulse-width scan, Density scan, and Heating-energy change were performed.

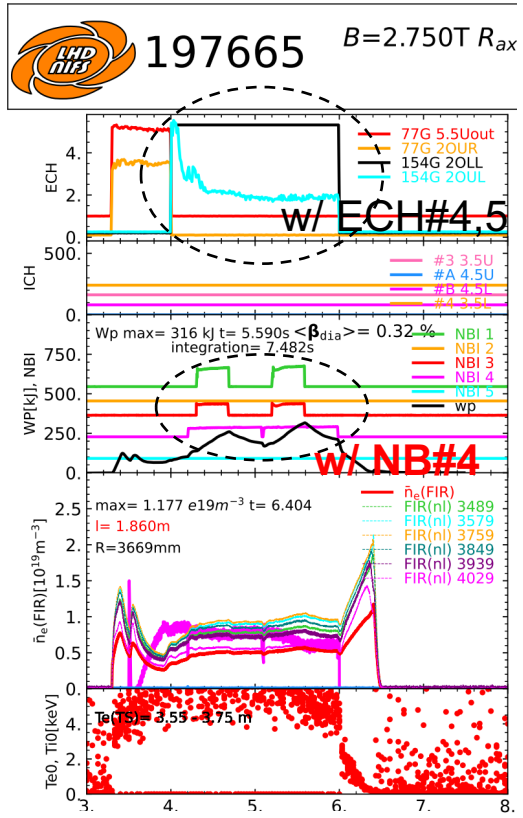
Results:

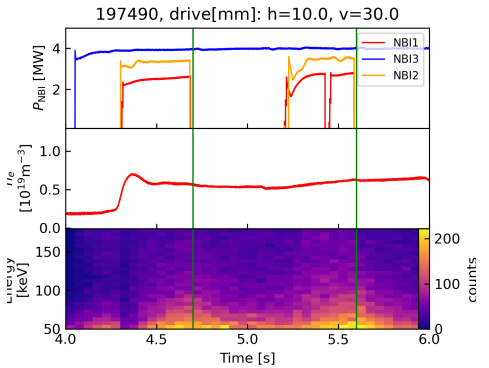
- Unfortunately, there was no experiment that could be compared to the previous day's experiment…
- Fast-ion energy decay was observed in NPA, but PCI can't calculate turbulence profile in ctr-dominant heating condition

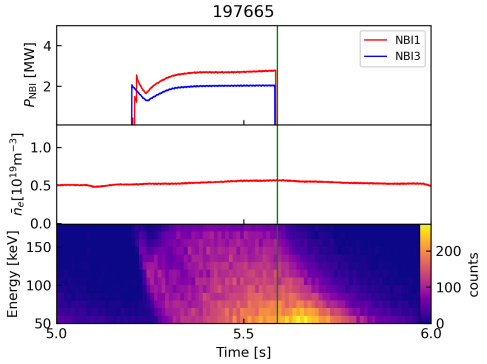
11/20 (previous day)



11/21 (this day)







Dependence of resonance layer shape and antenna on heating efficiency of minority ion heating

R. Seki

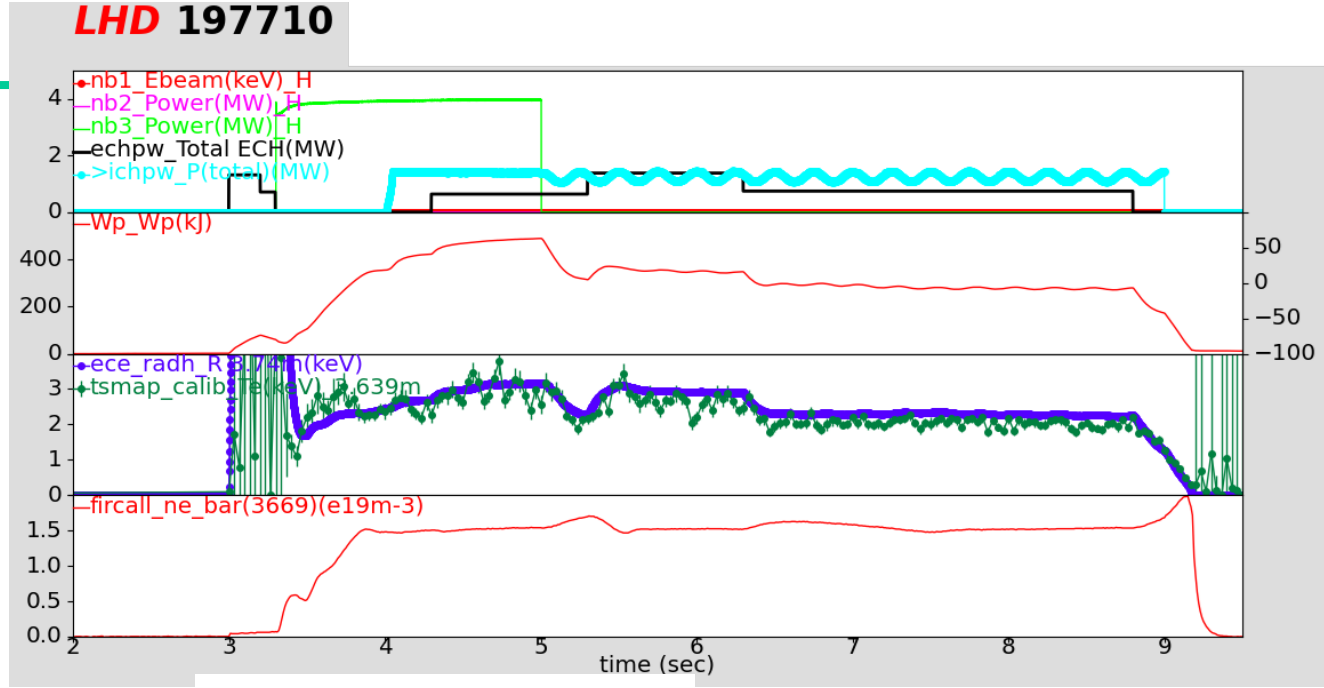
Experimental conditions: antenna from plasma: 10 cm
(R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CW, 2.727 T, 1.2538, 100.0%)
#197674 – #197693
(R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CW, 2.5 T, 1.2538, 100.0%)
#197694 – #197713

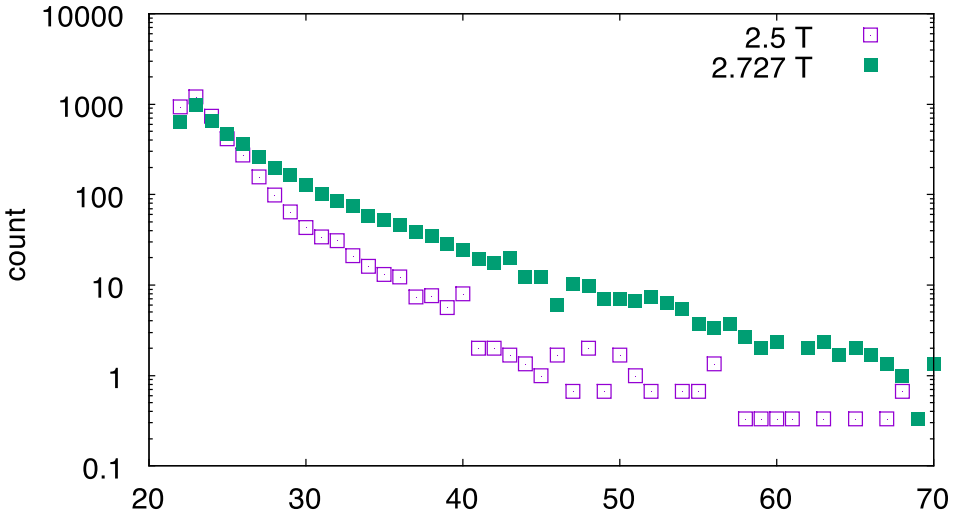
Motivation:

- In LHD, the shape of resonant layer changes with the field strength, and the ICRF propagation and fast ion confinement changes accordingly.
- To investigate the effect of resonance layer shape, dependence of fast ion tail and efficiency on proton ratio was investigated.

Results:

- The response of the plasma stored energy by ICRF power modulation was observed for the evaluation of the efficiency.
- The ICRF minority proton ion tail was measured by changing the resonance layer shape with DNPA. In the case of Bax=2.727 T, fast ion tail can be measured with he DNPA in both inner and outer region.





Fast ion measurement (DNPA:CH1(inner))