Daily Report for 2025-12-12

Y. Takemura

Date: December 12, 2025
Time: 10:00 – 18:45
Shot: 199214 – 199363 (150 shots)
Prior wall conditioning: He
Divertor pump: On
Gas puff: H2, N2, Ne, Ar
Pellet: H2 pellet
LID: Yes
NBI: #1, #2, #3, #4, #5
ECH: 2-OUR (77GHz), 5.5-UO (77GHz), 2-OUL (154GHz), 2-OLL (154GHz)
Topics

1. Diagnostics of relativistic electrons by Thomson scattering in high electron temperature plasmas (Hisamichi Funaba)
2. Demonstration of plasma parameter optimization by the data assimilation control system ASTI with plasma navigation (Sadayoshi Murakami)
3. Investigation of the effects of impurity powder dropping on the transport of the first wall material in LHD (Suguru Masuzaki)
4. Development of steady state detachment scenarios at LHD (Marcin Jakubowski)
5. Excitation of stable Alfven eigenmodes by ice pellet injection in finite beta plasmas heated by electron cyclotron waves and the destabilization by energetic ions (Kazuo Toi)

Diagnostics of relativistic electrons by Thomson scattering in high electron temperature plasmas

H. Funaba

Experimental conditions:

(R_{ax}, Polarity, B_t, γ, B_q) = (3.55 m, CCW, 2.7887 T, 1.2538, 100.0%)
#199214 – #199231, He GDC in the previous day

Motivation and method:

(1) Measurement of non-Maxwellian distribution of electron velocity by polychromators with more channels.
(2) In 25th cycle, the high repetition rate laser was not available. This laser is needed in order to obtain the Thomson scattered signals by 100 laser pulsers within 5ms.

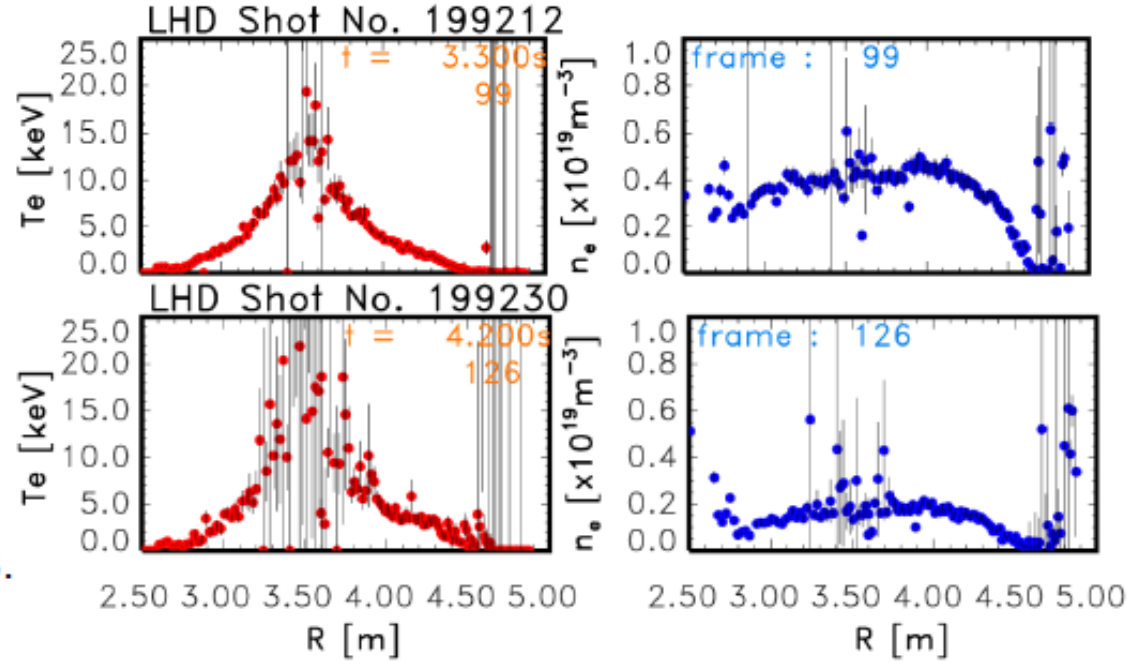


Fig.1: Profiles of electron temperature and density without accumulation.
#199212) 4 lasers were used.
#199230) 3 lasers were used.

Results:

(1) As the electron density increased at first, NBI#1,2,3 were used for wall conditioning. The density rise was suppressed.
(2) ECH plasmas with n_e <= 2 x 10^{18} m^{-3} were obtained.
(3) Four lasers (two 30Hz and two 10Hz) were used until #199215.
(4) 100 signals are accumulated by the high repetition rate laser .
(5) Although the error is large since T_e > 15keV is not suitable for 5-channel polychromators, T_e seems to reach at about 20 keV at n_e ~ 2 x 10^{18} m^{-3}.

Demonstration of plasma parameter optimization by the data assimilation control system ASTI with plasma navigation (S. Murakami, Y. Morishita, N. Kenmochi)

Shot #: 199232-199277

Experimental conditions:

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

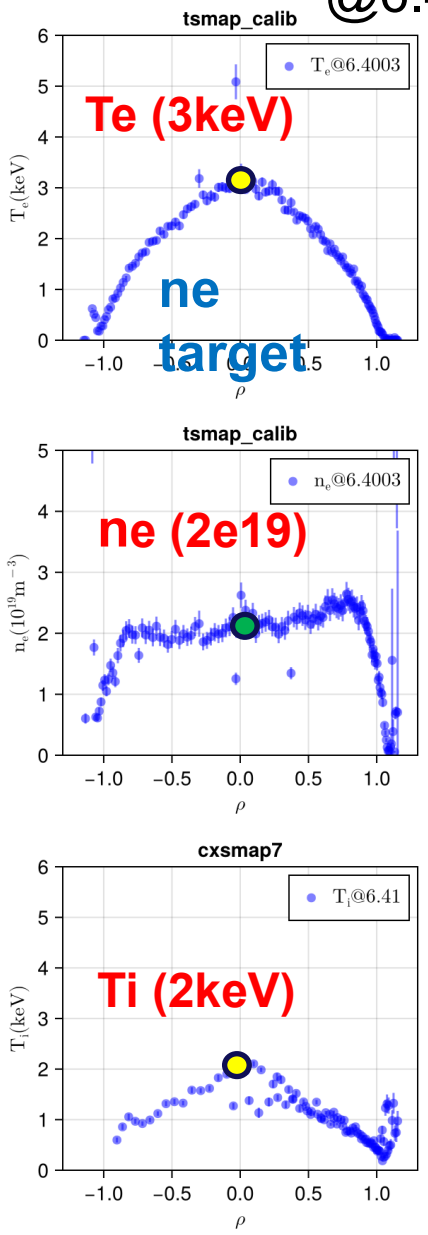
Motivation and objective:

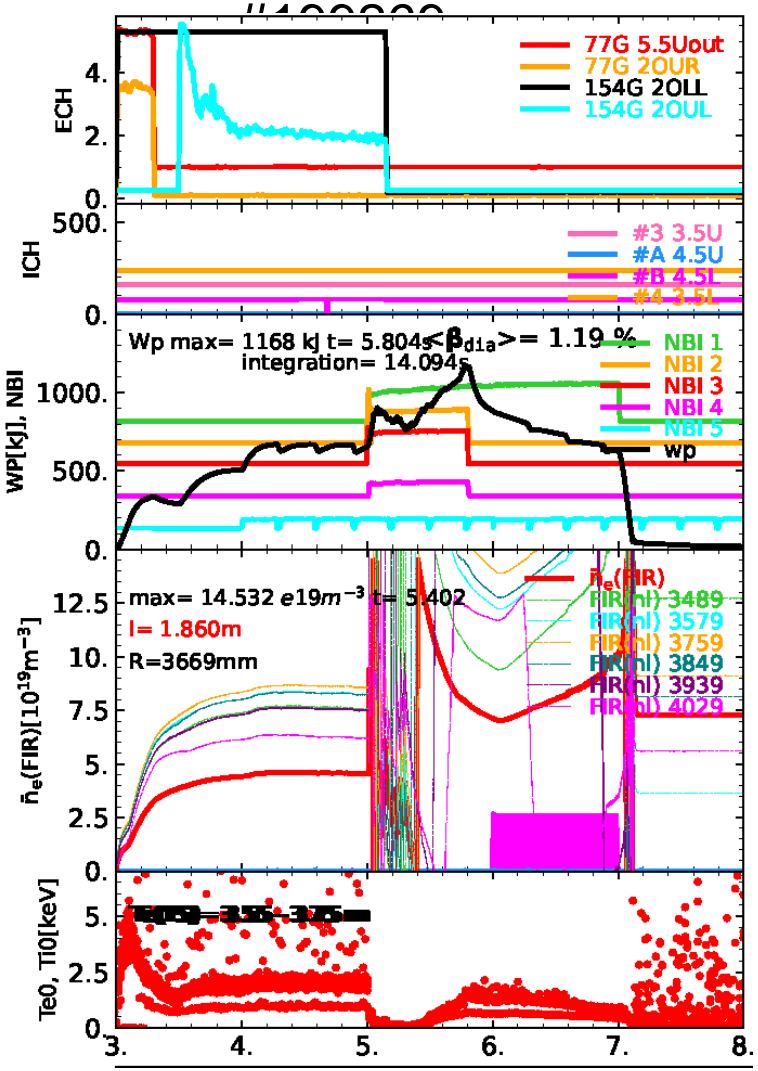
To demonstrate the real-time plasma control and plasma parameter optimization using ASTI running at the new PS@Rokkasho.

Results:

- 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.
- Modifications are required to apply the transport model used in ASTI to annealing experiments, and a series of shot data were collected for this purpose.
- In next week's experiment, we plan to conduct experiments on triple-product optimization via annealing using ASTI.

@6.4 s





Long pulse detached scenarios

M. Jakubowski, M. Kobayashi

Experimental conditions:

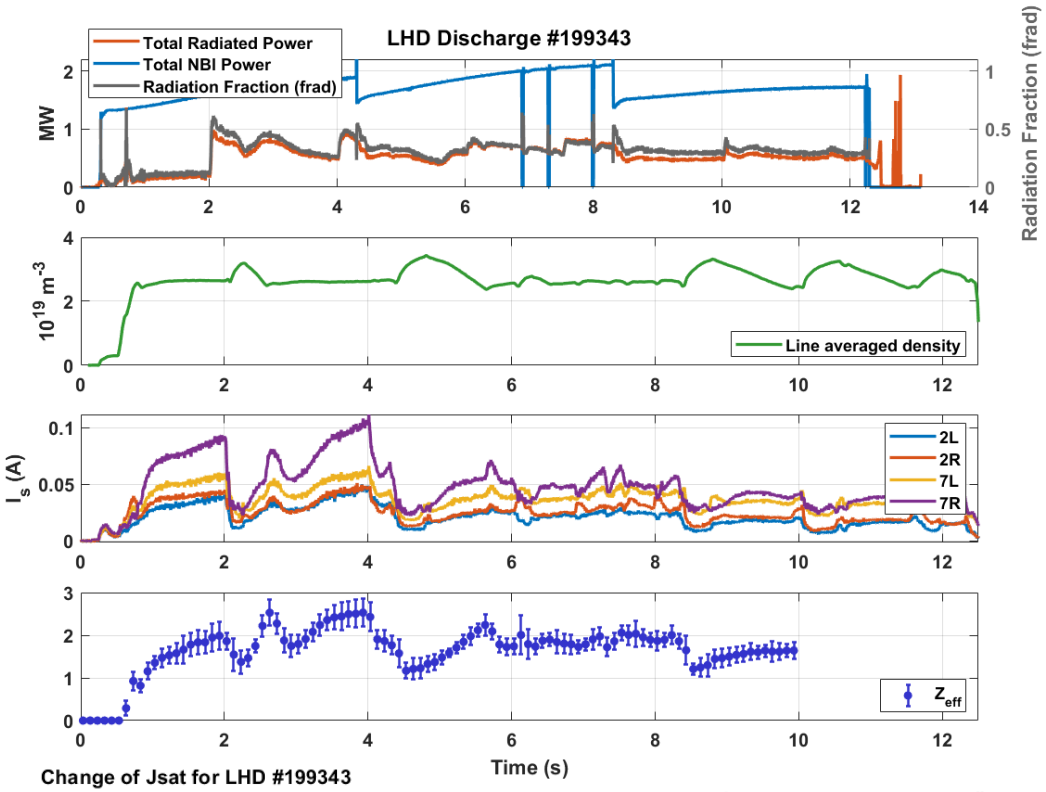
(R_{ax}, Polarity, B_t, γ, B_q) = (3.85. m, CCW, 2.54 T, 1.2538, 100.0%)
#193709 – #193763

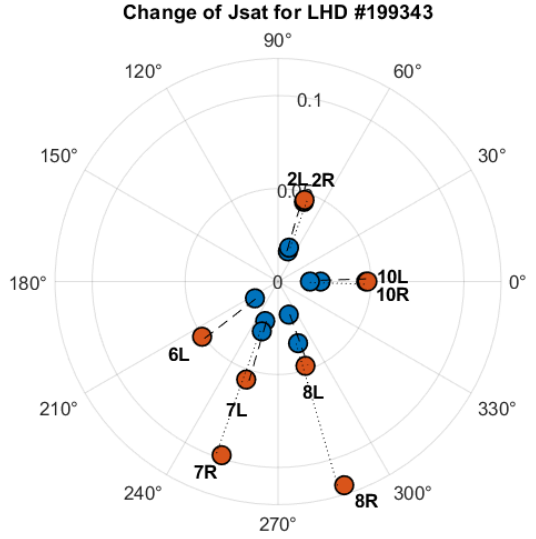
Motivation and method:

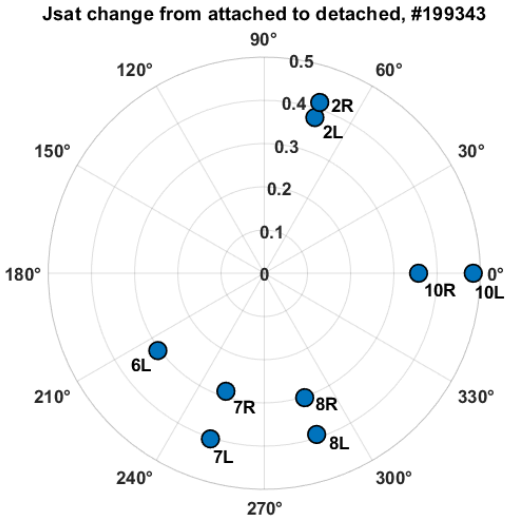
- Comparison of steady-state detachment with seeding Ne between LHD and W7-X
- The optimum scenario: highest radiation levels without core contamination → Detachment will be stabilized with RMP coils.
- The scenario will be prolonged in time to explore the compatibility of such scenarios with time scales of wall recycling (12 s).

Results:

- Available NBI power was slightly lower than last year.
- Lower levels of Zeff when compared with last year results.
- Succesful scenario for steady-state detachment with jsat ca. 50-60% reduced comparing to attached state







Investigation of the effects of impurity powder dropping on the transport of the first wall material in LHD

S. Masuzaki

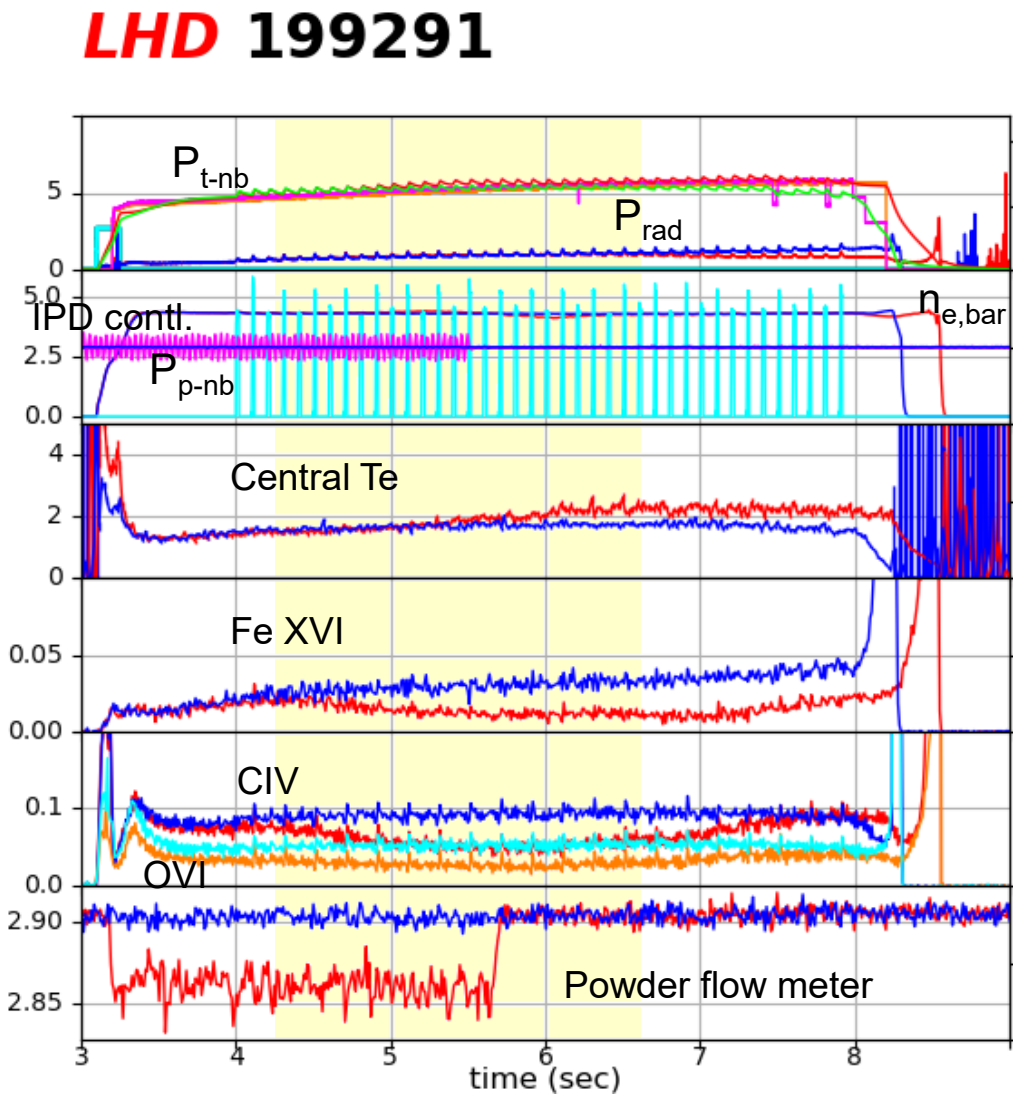
Shot #: 199281 – 199320
(R_{ax}, B_t, γ, B_q) = (3.6 m, -2.75 T, 1.2538, 100.0%) ,
Working gas: H2, IPD: B, Si, Li
P_{ECH}～3 MW, $P_{t\text{-}NBI}$～ 5.6 MW (pulse length:5 s),
$P_{p\text{-}NBI}$~5 MW/injector (modulated (20ms injection/200ms interval)

Background and Purpose

- In the LHD, impurity powder injection has been observed to affect the transport of iron, the first wall material.
- The objective of this study is to clarify how impurity powder injection affects the iron transport.
- Spectroscopic data show that changes in iron transport occur on a timescale of seconds. Therefore, experiments were conducted using long-pulse neutral beam injection (NBI).
- In this experiment, particular attention was paid to the recovery process following the termination of powder injection.

Result

- Impurity powder injections of B, Si, and Li were carried out at background electron densities of 2, 4, and 6E19/m^3, respectively.
- In all powder cases, reduction of Fe XVI emission was observed.
- Time evolutions of other iron lines intensities, and their vertical profiles will be analzyed.



Typical time evolutions of w/ and w/o B powder injection. Powder is injected into the plasma at the yellow-hatched timing. #199291 (w/ B), 199286 (w/o B)

Excitation of stable Alfven eigenmodes (AEs) by ice pellet injection in finite-β plasmas heated by electron cyclotron waves and the destabilization by energetic ions

K. Toi and K. Ogawa

Experimental conditions:

(R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CCW, 1.375 T, 1.2538, 100.0%)
#199344 - #199363

Motivation and method:

- To clarify the excitation mechanism of stable AEs by ice pellet injection in finite beta-plasmas and the transition to unstable state of AEs by energetic ions.

Results:

- Excitation of AEs by ice pellet injection was attempted in ECH plasmas at low Bax(=1.375T). Relation between the AEs excited by the pellets and Eps was investigated.
- Very weak mode (AE1) is thought to be the AEs excited near the edge by ice pellet injection without EPs. During the #1 NBI (co-EPs), the weak AE2 in the same frequency rage with AE1 is destabilized also near the edge by EPs.
  The bursting AE3 related to the n=1, m=2+3 TAE gap is strongly destabilized near the plasma central region by the #1 NBI.
- More quantitative discussions are needed.