



Date: Feb. 3, 2022, Time: 13:22~18:45, Shot#: 178150~178242 (shots)

Prior wall conditioning: No, Divertor pump: On (except for 2-I)

Gas puff: H₂, Ne, N, Ar, SSGP: No, Pellet: No, LID: Yes

NBI#(1, 2, 3, 4, 5)=gas(H, H, H, H, H)=P(3.72, 2.24, 4.33, 5.49, 4.69)MW

ECH(77GHz)=ant(5.5-U, 2-OUR)=P(0.70, 0.79)MW,

ECH(154GHz)=ant(2-OLL, 2-OUL, 2O-LR)=P(0.72, 0.80, 0.83)MW

ICH(3.5U, 3.5L, 4.5U, 4.5L) = P(0.83, 0.77, 0.78, 0.38) MW

Neutron yield integrated over the experiment = 3.7×10^{11}

Topics

1. Investigation of impurity seeding from inner ports (S. Masuzaki)
2. Toroidal asymmetric behavior of divertor heat load by N₂ seeding from 3-I (K. Mukai)
3. Study of detached plasma condition with and without divertor pumping
(C.P. Dhard, D. Naujoks (IPP), G. Motojima, S. Masuzaki)
4. Accumulation of confinement data in the case of significant ion heating (H. Yamada, R. Sakamoto)

Impurity seeding from inner ports

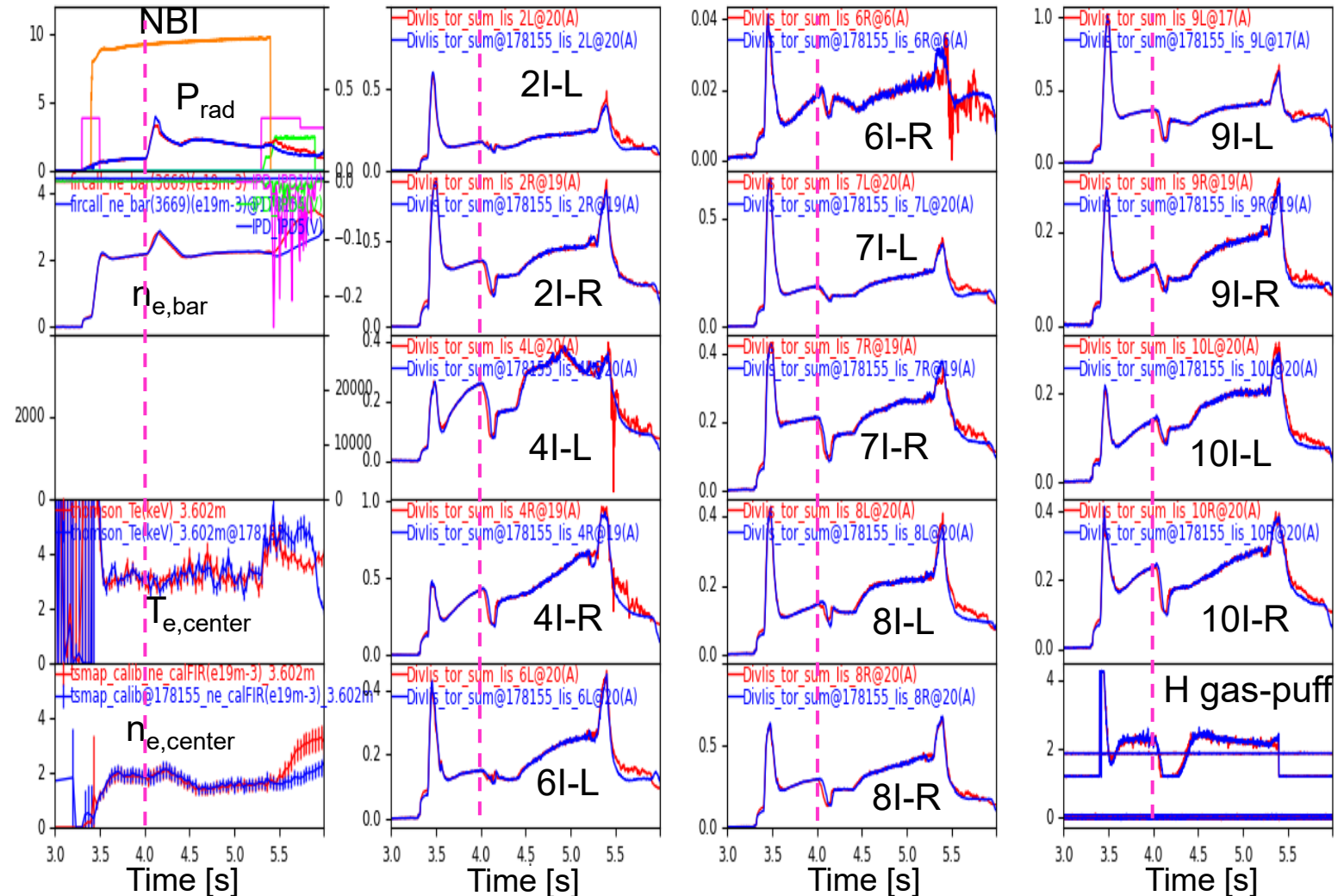
Shot #: 178150-178166, 178188-178202, (R_{ax} , B_t , γ , B_q) = (3.6 m, -2.75 T, 1.2538, 100.0%)

Working gas: H₂, Seeding gas: N₂, Ne, Ar

$P_{NBI1} \sim 4$ MW, $P_{NBI2} \sim 2$ MW, $P_{NBI3} \sim 4$ MW, $P_{ECH} \sim 3.5$ MW only for start-up

red: 5.5L puff (#178157), blue: 3l puff (#178155)

- ✓ N₂, Ne and Ar seedings were carried out using the 5.5L and the new valves at 3l.
- ✓ Comparisons of time evolutions of plasma parameters between similar impurity seeding from 3l and 5.5L valves in low ($n_{e,bar} \sim 2E19/m^3$) and high ($\sim 5E19$) density plasmas are ongoing.
- ✓ It was found that in the cases of Ne puff, time evolutions of divertor ion flux do not depend on gas puff port.



Toroidal asymmetric behavior of divertor heat load by N₂ seeding from 3-I (piggyback) K. Mukai

Background and objective

- Toroidal asymmetric behavior of divertor heat load by impurity seeding occurs due to the localization of radiative cooling. The radiation localized along the magnetic field lines pass through the position of impurity seeding. [H. Tanaka et al., NME 2017, K. Mukai et al., ITC30]
- It can be considered that $I_{\text{sat, div}}$ decreases by impurity seeding when the magnetic field lines from the seeding position is connected to the divertor.
- Injection port dependence of the asymmetry was investigated using the new 3-I puff.

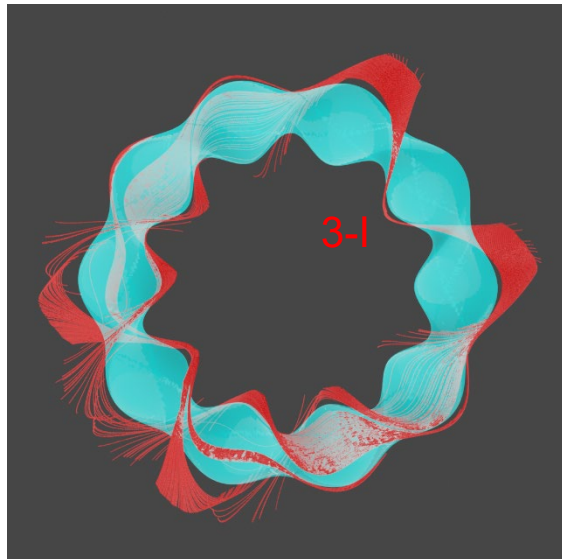
Experimental condition

- #178188 - #178202
- $(R_{\text{ax}}, B_t, \gamma, B_q) = (3.60 \text{ m}, 2.75 \text{ T}, 1.254, 100\%)$
- NBI #1, 2, 3
- $n_{e, \text{bar}} \sim 2, 5 \times 10^{19} \text{ m}^{-3}$

Results

- Injection port dependence of the asymmetry was observed.
- In some toroidal sections, behavior of $I_{\text{sat, div}}$ was different from the prediction.
- The magnetic field line trace will be scanned finely to investigate the effect of ergodic layer.
- Density dependence and radiation profile will be analyzed.

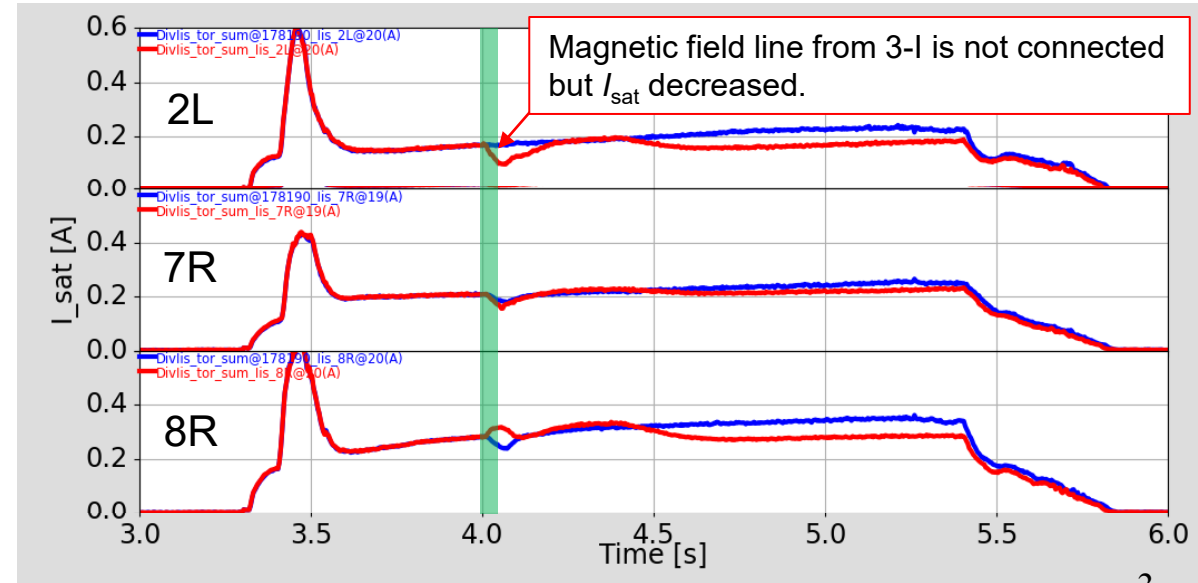
Trace of magnetic field lines



O: connected, X: not connected, Δ : marginal

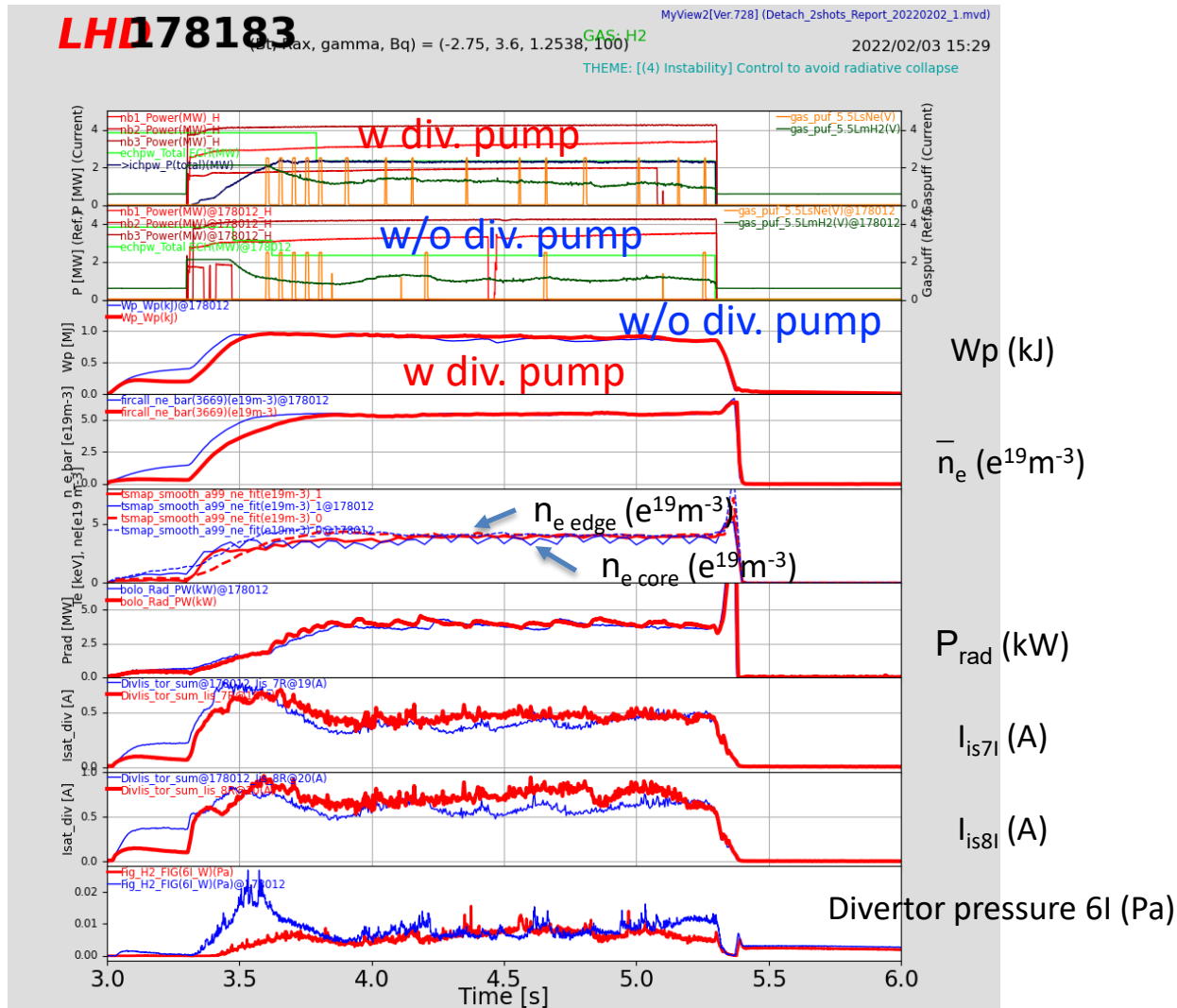
Tor. Section	Left div.		Right div.	
	3-I	5.5-L	3-I	5.5-L
1	O	Δ	X	Δ
2	X	X	X	O
3	X	O	X	O
4	X	O	X	X
5	X	X	O	X
6	Δ	X	O	X
7	X	X	O	O
8	X	X	X	O
9	O	O	X	X
10	O	X	Δ	X

$n_{e, \text{bar}} \sim 2 \times 10^{19} \text{ m}^{-3}$ N₂: 3-I (#178189), 5.5-L (#178190)



Study of detached plasma condition with and without divertor pumping (C.P. Dhard, D. Naujoks (IPP), G. Motojima, S. Masuzaki(NIFS))

✓ Experimental conditions: Shot No: 178167-178183, B_t , R_{ax} , γ , $Bq = (-2.75, 3.6, 1.254, 100)$



- ✓ Experimental data for the time when the NBI was in the deuterium (D) phase (2021/11/26, 2021/12/3) has been already obtained.
- ✓ In the present study, we have obtained the data when the NBI was in the hydrogen phase (H).
- ✓ In the case that the **divertor pumping is working**, the **larger amount of neon** is required.
- ✓ Comparing the divertor flux and divertor pressure with and without divertor pumping, the difference in the detachment conditions will be analyzed.

Accumulation of confinement data in the case of significant ion heating (H.Yamada, R.Sakamoto et al.)

Background and objective

- Compilation of confinement database has been enriched, in particular, for investigation of isotope effect.
- Nonetheless, the case with perpendicular NBI heating was shortfall in the database.
- Fulfilling data with significant ion heating is inevitable for further comprehensive study of isotope effect.

Experimental Condition

- $R_{ax}=3.6\text{m}$, $B=1.64/2.75\text{T}$ ($M^{3/4}$), Scanned density and power under the condition with NBI#4 injection
- Purity of H as high as 90% has been secured.

Results

- Significant extension of database in the case with perpendicular NBI heating.
- H at 2.75T: 7 cases \rightarrow +17 cases, at 1.64T: 5 cases \rightarrow +20 cases

Scope

- These H data are to be paired with the D data from the experiment on Nov. 2nd in 2021.
- Revisit to the scaling law of energy confinement time and dimensionally similar comparison of thermal transport including the case with significant ion heating.

