

(MAP) Session Report



Date: June 11, 2024

June 12, 2024 (K. Mukai, M. Shoji)

Time: 10:30 – 16:45

Shot#: 192929 – 193032 (104 shots)

Prior wall conditioning: None

Divertor pump: Off

Gas puff: H₂, Ne

Pellet: None

NBI#(1, 2, 3, 4, 5) = gas(H, H, H, -, -)=P(1.8, 2.1, 2.3, 3.3, 2.8) MW

ECH(77GHz) = ant(1.5-Uo, 5.5-U, 2-OUR)=P(-, 0.70, 0.38) MW

ECH(154GHz) = ant(2-OLL, 2-OUL, 2-OLR)=P(0.71, 0.81, 0.98) MW

ICH(3.5U, 3.5L, 4.5U, 4.5L) = P(-, -, -, -) MW

Topics

1. Long-pulse steady-state shots in the 3.55 m configuration (U. Wenzel (IPP))
2. Exposure of material samples into the LHD edge plasma by means of the manipulator (C.P. Dhard)
3. Development of steady-state detachment scenarios at LHD (M. Jakubowski)



Long-pulse steady-state shots in the $R_{ax} = 3.55$ m configuration (U. Wenzel (IPP), G. Motojima)

✓ Experimental conditions:

#192932-192953𯇈-192974:

$R_{ax}=3.55$ m, CCW, $B=2.78$ T, $\gamma=1.254$, $B_q=100\%$

#192711-192728: $R_{ax}=3.53$ m, CCW, $B=2.804$ T, $\gamma=1.254$, $B_q=100\%$

✓ Motivation

- ❖ In the 24th LHD campaign, very high neutral pressures were measured in the sub-divertor region (Wenzel et al., Nuclear Fusion 2024). The divertor went into a low temperature mode (LTM).

❖ It is proposed to

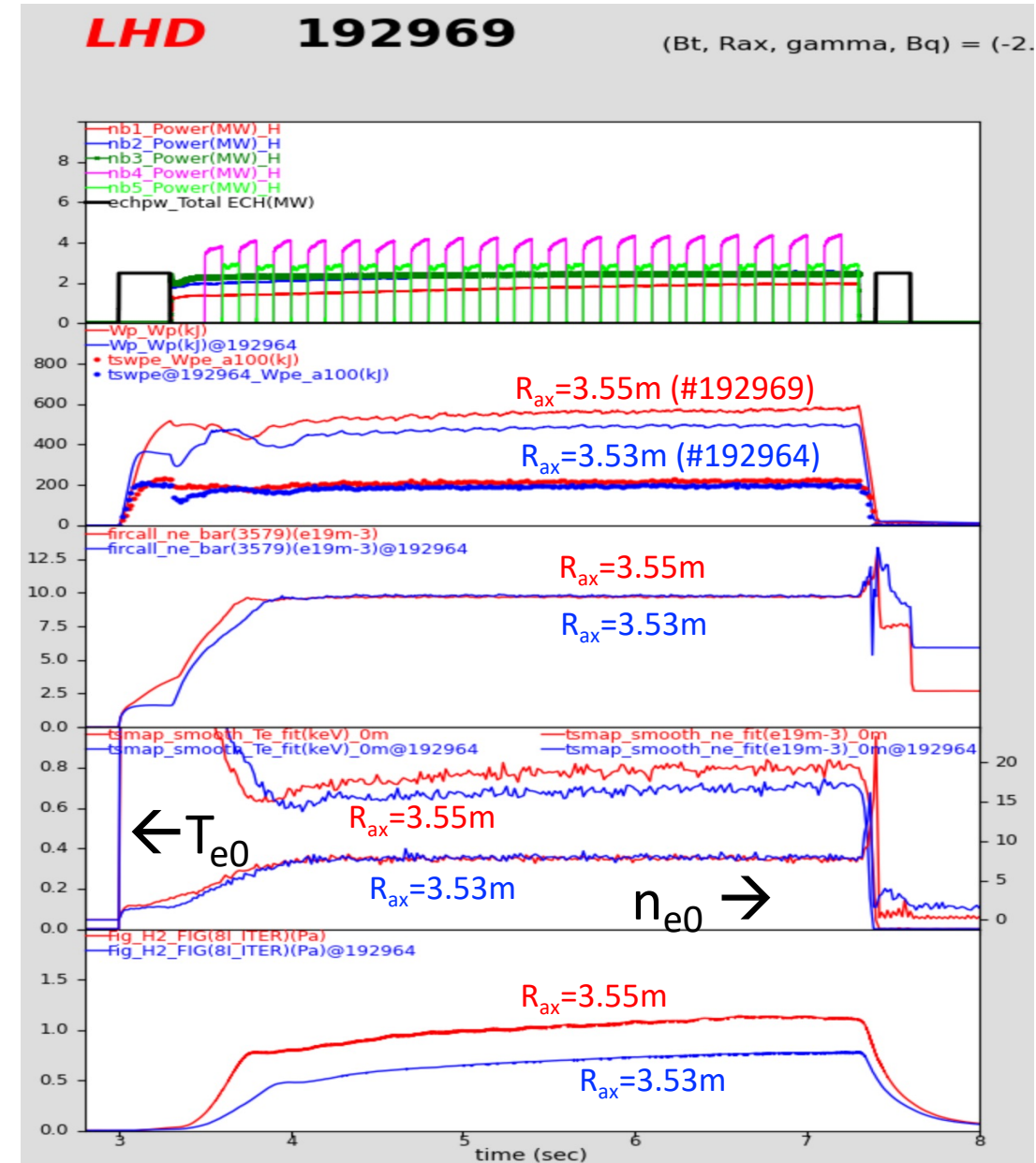
- 1) Verify the result and determine the threshold for the transition
- 2) Generate a steady-state shot for long pulse discharges.

✓ Experiments

- ❖ Density ramp up for confirmation of reproducibility
- ❖ Density steady state ($8-11 \times 10^{19} \text{ m}^{-3}$)

✓ Results

- ❖ High neutral pressure (~ 1 Pa) is successfully observed in density steady state of $R=3.55$ m, CCW condition for long pulse NBIs.
- ❖ More inward ($R=3.53$ m) the effect was also observed but neutral pressure was lower compared to $R=3.55$ m.



Exposure of material samples into the LHD edge plasma by means of the manipulator

C.P. Dhard, D. Naujoks (IPP), S. Masuzaki

Shot #: 192975 – 192991, Cycle: 3 min. 30s.

$(R_{ax}, B_t, \gamma, B_q) = (3.6 \text{ m}, -2.75 \text{ T}, 1.2538, 100.0\%)$, Working gas: H2

$P_{ECH} \sim 0.4 \text{ MW}$, $P_{t-NBI} \sim 7 \text{ MW}$ (pulse length: 4s),

$P_{p-NBI} \sim 3 \text{ MW}$ (modulated, pulse length: 12s)

Objectives

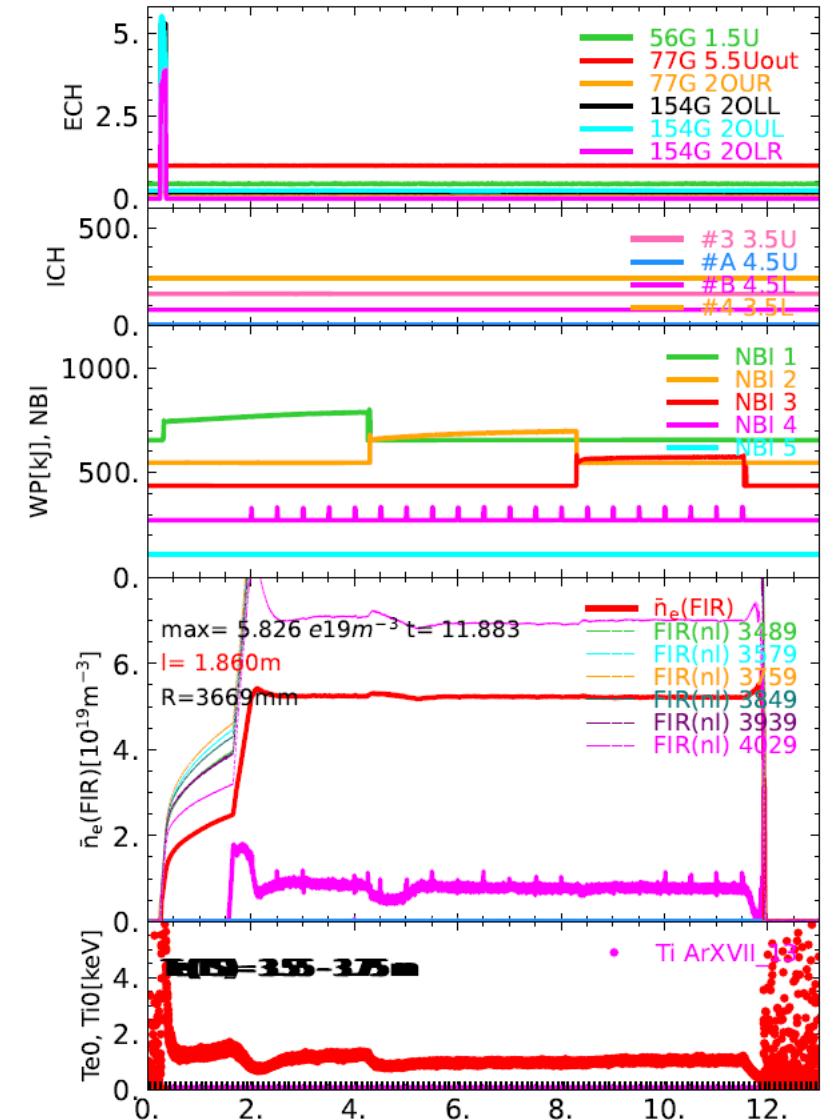
- To form FUZZ-like nanostructure on surfaces of W alloy samples by exposing to He plasma.
- The samples with the FUZZ-like structure will be exposed to H plasma in the next experiment to investigate the change of surface morphology.

Method

- Three sets of W-alloy samples (W95NiFe, W97NiFe), and one set of W samples were installed to the position of the divertor strike point by using the manipulator at 10.5L port.
- The W-alloy samples had been exposed to He plasma in 25s. Discharge sustained by ECH and ICH on 15 April.

Results

- Samples were exposed to H plasma from 192981 to 192991 (11 shots)
- Surface analysis will be conducted.



Typical time evolutions of heating power, n_e , gas puffing, Te in this experiment (#192988)

Development of steady-state detachment scenarios at LHD

Marcin Jakubowski (IPP), Masahiro Kobayashi (NIFS)

Motivation & Objectives:

- Based on the previous experiments at LHD and W7-X scenarios for steady-state detachment with seeding low-Z species (Ar or Ne) will be developed.
- 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.

Results:

$R_{ax} = 3.90\text{m}$, $B=2.54\text{T}$, CCW, $\gamma=1.254$, $Bq=100\%$.
 NBI $\sim 2\text{MW}$ with 4 sec pulse in train. $I_{RMP} = 2.8$ and 2.0 kA

The discharge is extended to 12 sec with 3 NBIs in train. The Ne was seeded from 5.5L valve at 2.0s (12ms), 4.5s (4ms), 8.0s (2ms), 10 s (2 ms). The detachment was sustained from $t = 2.0$ to 12.3 sec. The duration is longer than wall recycling time.

The divertor particle flux was decreased at least in all measured toroidal section with divertor probe array.

I_{RMP} and power was scanned. The data will be analyzed to investigate dependence on power and I_{RMP} , and to be compared with W7-X.

