(TG1) Multi-ion group report

Dec. 26, 2022 (G. Motojima)

Date: Dec. 23, 2022
Time: 13:12-18:42
Shot#: 187093-187154 (62shots)

Prior wall conditioning: No

Divertor pump: No
Gas puff: He, Ar
H/D pellet: No

NBI#(1, 2, 3, 4, 5) = gas(H, H, H, H, H) = P(-,2.2,2.2,3.8,-)MW

ECH(77 GHz) = ant(5.5-Uout, 2-OUR) = P(209,0) kW
ECH(154 GHz) = ant(2-OLL, 2-OUL , 2-OLR) = P(205,203,237) kW
ECH(56 GHz) = ant(1.5U) = P(-) kW
ICH(3.5U, 3.5L, 4.5U, 4.5L) = P(0.57,0.52,0.7,0.38) MW
Neutron yield integrated over the experiment = 4.1×10^{13} (TG1)
Topics

1. Wall conditioning for the H to He wall change-over (S. Masuzaki, G. Motojima)
2. Impact of impurity powder dropping on He plasma (S. Masuzaki)
3. Exposure of W samples to divertor plasma (C.P. Dhard, D. Naujoks (IPP), S. Masuzaki)

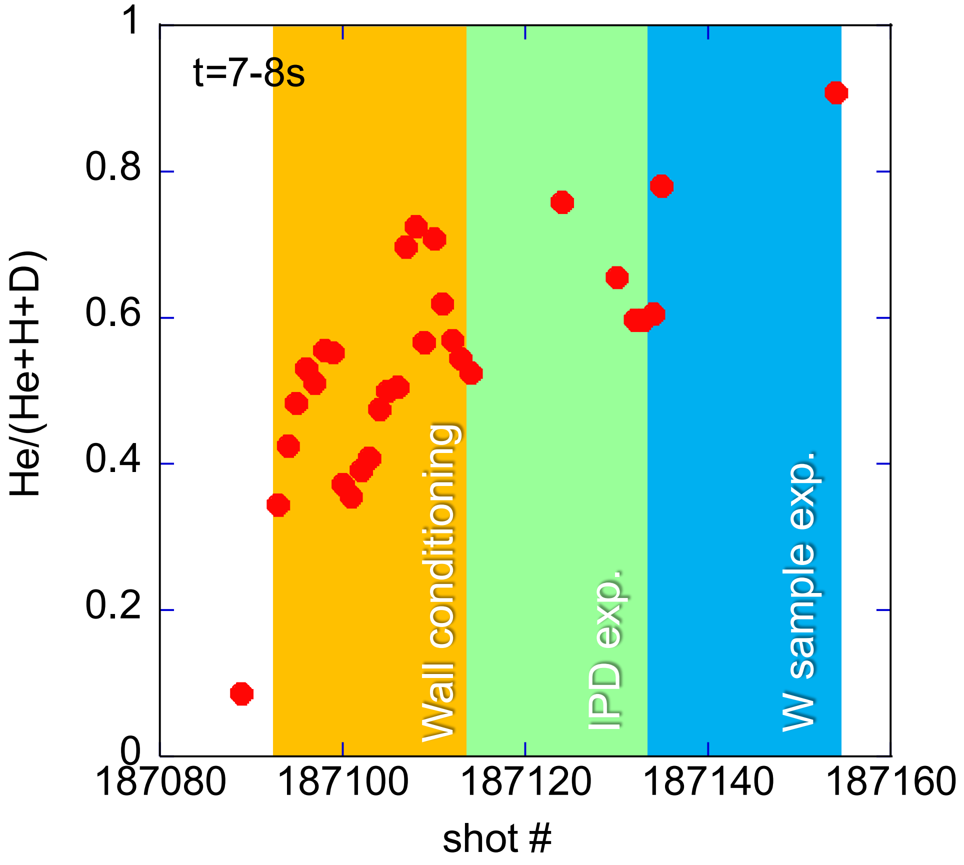
Wall conditioning for the H to He wall change-over

S. Masuzaki, G. Motojima

Shot #: 187093-187114
(R_{ax}, B_t, γ, B_q) = (3.6 m, -2.75 T, 1.2538, 100.0%)

Working gas: He
Heating: ECH 0.6 ~ 0.85 MW, ICH; 2.17 MW
PNBI-2 ~ 2.2 MW, PNBI-3 ~ 2.2 MW, PNBI-4 ~ 4.5 MW

- To conduct helium plasma experiment just after hydrogen plasma experiment, wall conditioning for hydrogen to helium wall change-over was conducted by mainly using long pulse (~35s) discharges sustained by ECH and ICH.
- Data of the passive spectroscopy shows that the wall conditioning (22 shots) increased the He ratio from 0.1 to ~0.6.
- The He ratio changed with change of electron density and heating power.
- The He ration in the core plasma will be analyzed by using CXS data.



Shot by shot evolution of the He ratio at t=7-8s (passive spectroscopy)

Impact of impurity powder dropping on He plasma

S. Masuzaki

Shot #: 187115-187134
(R_{ax}, B_t, γ, B_q) = (3.6 m, -2.75 T, 1.2538, 100.0%)
Working gas: He
Heating: ECH 0.6 ~ 0.85 MW,
PNBI-2 ~ 2.2 MW, PNBI-3 ~ 2.2 MW, PNBI-4 ~ 4.5 MW,
PNBI-5 ~ 4 MW

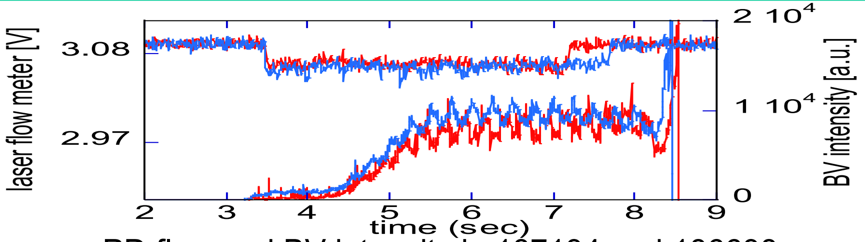
Motivation: It has been observed that the B powder dropping improves not only the wall conditioning but also plasma confinement by affecting turbulence in H and D plasmas. Similar effect on turbulences have been observed with C and Li powder droppings, respectively.

The mechanisms of the powder dropping on turbulences and are still not clear at present. In this experiment, the powder dropping experiment in He plasma to see whether the effects are different between in H/D plasma and He plasma.

Experiment: He plasmas with densities of j1, 2.5, 3, and 4 E19/m3 were sustained by t-NBIs for ~ 5 s and density was controlled by feedback. B or Li powder was dropped for 4 s during a discharge.

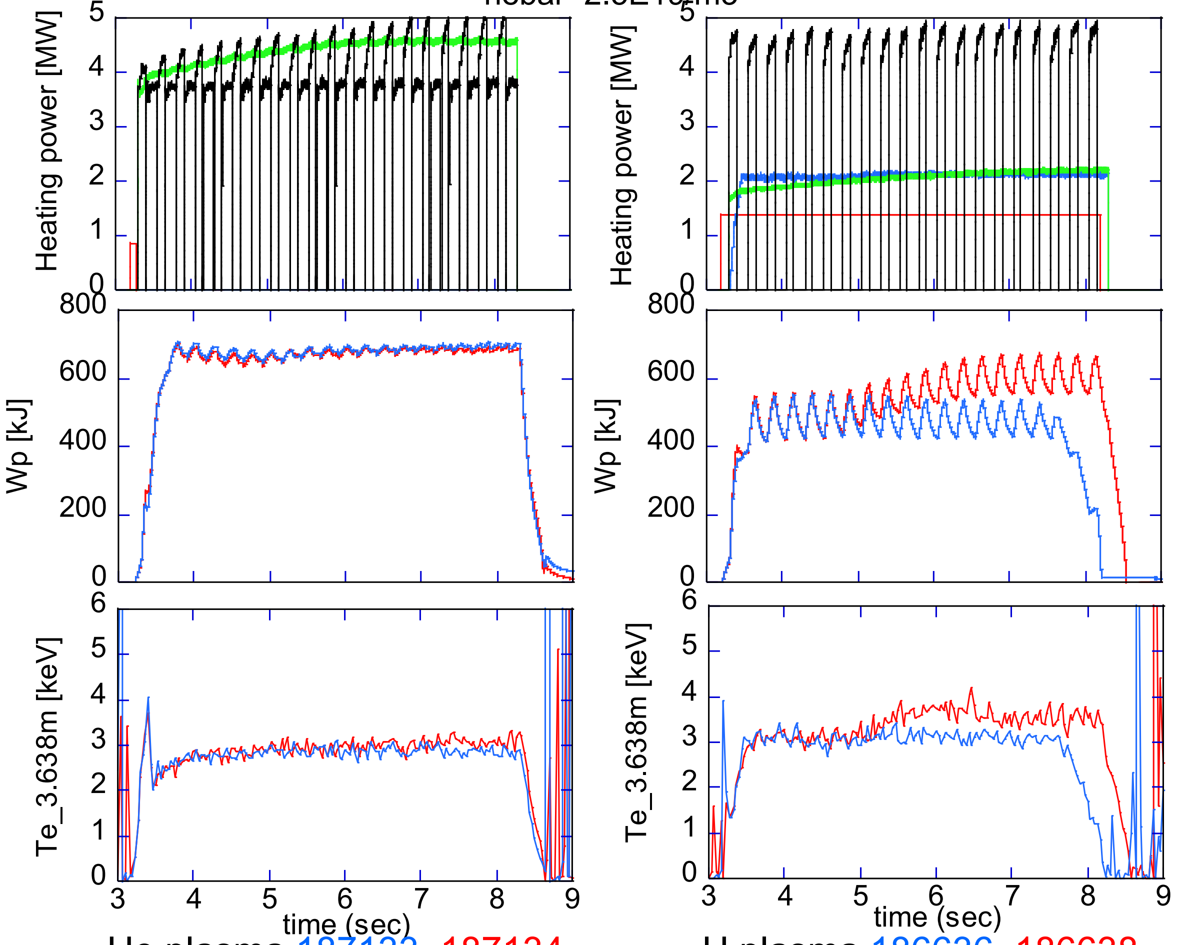
Results:

- ✓ Effects of B-PD on plasma confinement seems to be weaker in He plasma than in H plasma. But further analyses are necessary to conclude.



PD flow and BV intensity in 187134 and 186638

nebar~2.5E19/m3



He plasma 187133, 187134 H plasma 186636, 186638

Exposure of W samples to divertor plasma

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

Shot #: 187135-187154

(R_{ax}, B_t, γ, B_q) = (3.6 m, -2.75 T, 1.2538, 100.0%)

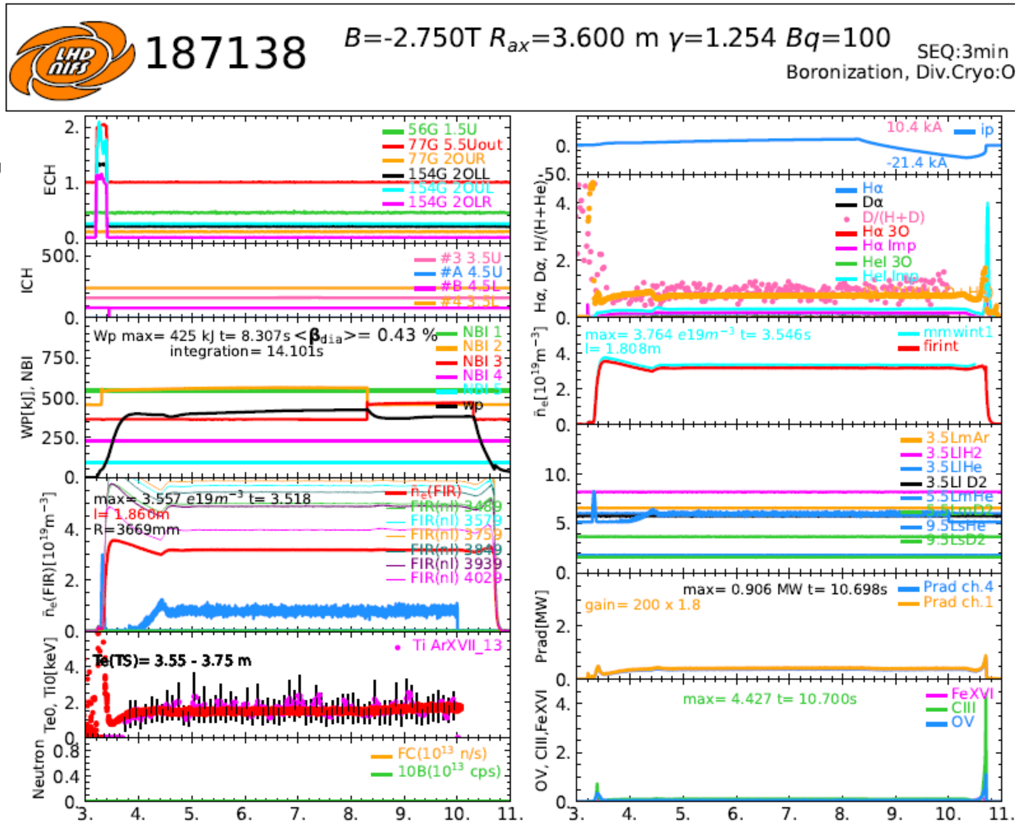
Working gas: He, Heating: ECH ~ 0.85 MW, PNBI-2 ~ 2.2 MW, PNBI-3 ~ 2.2 MW

Motivation

- Tungsten is appearing as a potential material for fusion reactor applications. However, because of its hardness and brittleness, it is not so easy to manufacture. W-alloys are being explored to overcome these problems.
- In this experiment, W-alloys samples are exposed to the LHD divertor plasma to investigate the effects of the helium plasma exposure on samples properties.
- Effects of hydrogen, deuterium, and helium plasma exposures on the materials will be compared.

Results

- Three sets of W alloy samples (W95%-Cu/Ni, W95%-Fe/Ni, W97%-Fe/Ni) and a set of pure W were exposed to divertor plasma using the manipulator at a 10.5L port.
- Total ~ 126s exposure was conducted.
- He/(H+D+He) ratio was ~ 75-80%
- Line averaged density was kept to be ~ 3E19/m3.
- Surface analyses will be conducted as soon as possible.



Typical shot