(MAP) Session Report

Date: Apr. 23, 2024
Time: 10:28 – 16:43
Shot#: 190009 – 190121 (113 shots)
Prior wall conditioning: H_2 GDC (4/20, 4/21)
Divertor pump: Off
Gas puff: H_2, Ar
Pellet: B, W
LID: On

Apr. 24, 2024 (R. Yanai)

NBI#(1, 2, 3, 4, 5) = gas(H, H, H, H, H)=P(4.7, 4.1, 4.2, 3.1, 3.2) MW
ECH(77GHz) = ant(1.5-Uo, 5.5-U, 2-OUR)=P(-, 0.698 0.38) MW
ECH(154GHz) = ant(2-OLL, 2-OUL, 2-OLR)=P(0.705, 0.889, 0.982) MW
ICH(3.5U, 3.5L, 4.5U, 4.5L) = P(-, -, -, -) MW

Topics

1. Database construction of boron ion emission lines (M. Goto)
2. Effect of boron impurity powder injection on tungsten impurity transport in the LHD core plasma (T. Oishi (Tohoku Univ.))
3. Spectroscopic analysis of divertor detachment (M. Goto)
4. The sustainment of divertor detachment by injection of impurity dust particles into the magnetic island in the LHD peripheral plasma using the IPD (M. Shoji)

Database construction of boron ion emission lines

M. Goto, K. Nojiri (QST) and T. Kawate

Experimental conditions:

(R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CW, 2.75 T, 1.2538, 100.0%),
(3.9 m, CW, 2.5385 T, 1.2538, 100.0%)

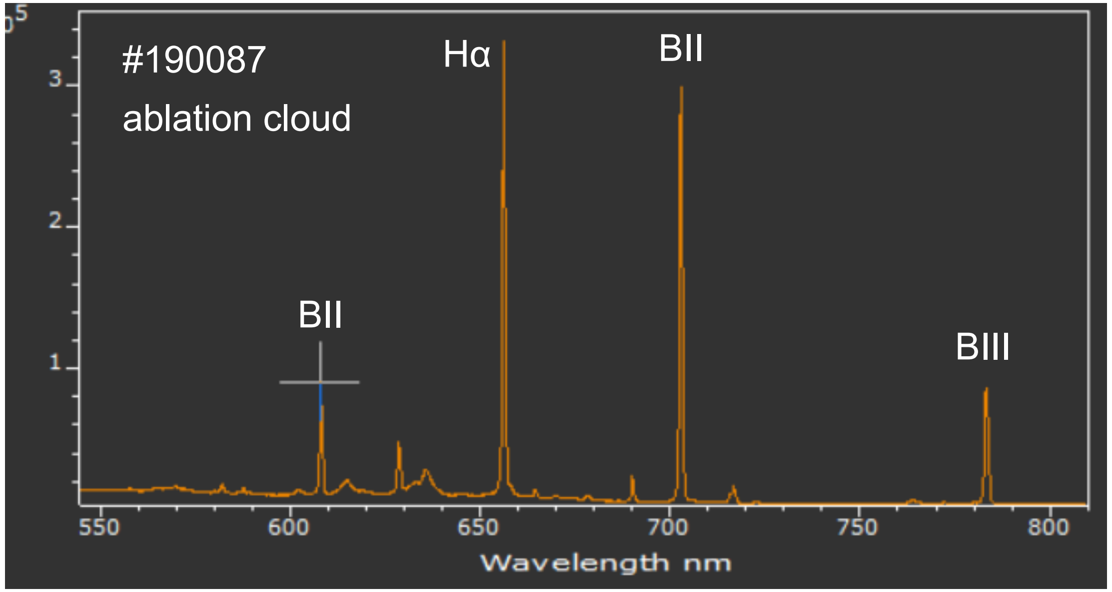
#190029 - #190030, #190070-190089

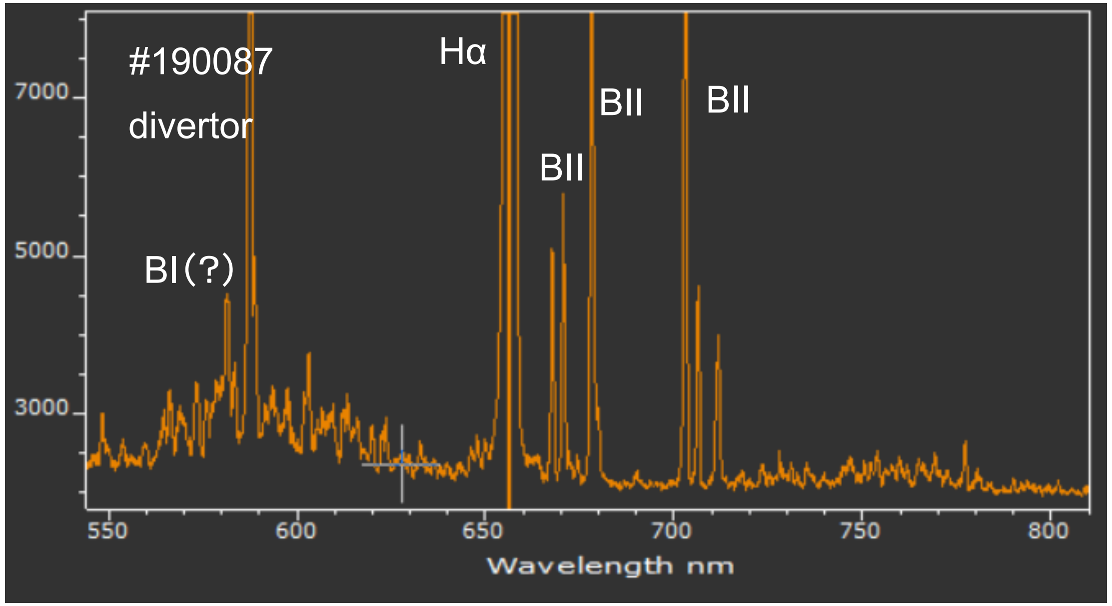
Motivation and method:

- ITER-DIM (Divertor Impurity Monitor) considers to use Boron emission lines for plasma parameter measurement.
- Boron IPD and pellets are used to accumulate data for emission lines of boron ions.
- The composition of the pellets used in this experiment are examined.

Results:

- It was confirmed that spectrum for the pellet ablation cloud mainly consist of boron ion emission lines.
- Localized line emissions of boron ions in the divertor were observed with the boron IPD discharge.





Effect of boron impurity powder injection on tungsten impurity transport in the LHD core plasma

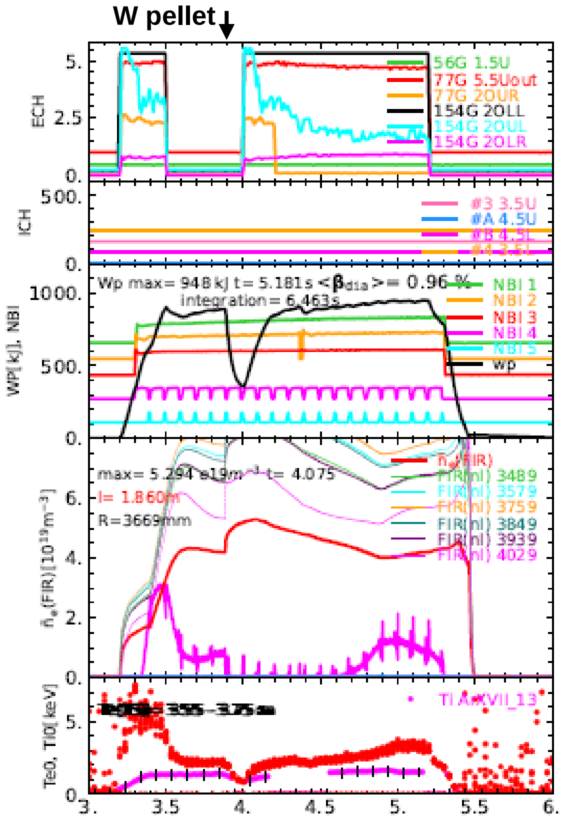
Apr. 23, 2024 T. Oishi (Tohoku Univ.)
Caretaker: S. Masuzaki

Conditions: R_{ax} = 3.6 m, B_t = 2.75 T, CW, γ = 1.2538, B_q = 100.0 % #190034-190069 (total 36 shots)

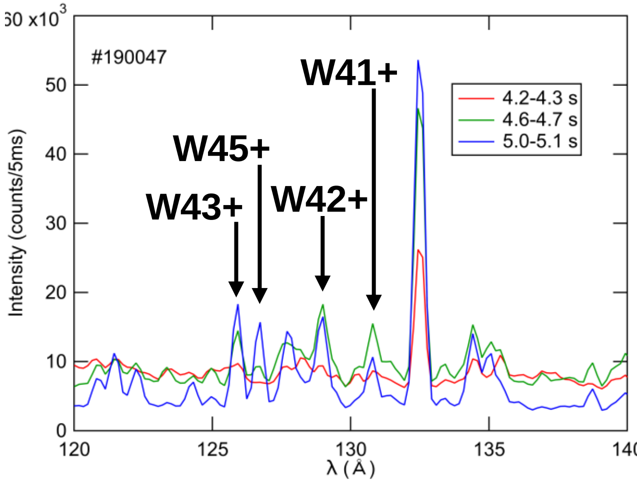
Objective: A significant reduction of iron impurities has been observed when boron powders are injected by the impurity powder dropper (IPD). -> Boron IPD has a potential to be an effective impurity control method. We aim to investigate the effects of boron IPD on tungsten impurity transport in the core plasma of LHD.

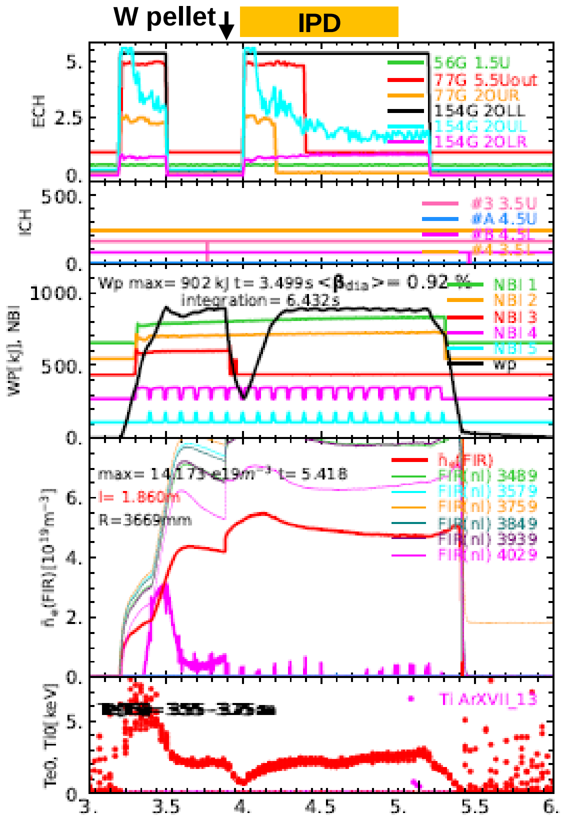
Results:

- For the discharges [w/ IPD, w/o IPD] x [n_e = 1, 2, 3, 4 x 10^{13}cm^{-3}], spectroscopic date were obtained in the EUV, VUV, and visible wavelength range.
- Although the discharge w/ IPD appears to have smaller line spectra of W^{41+}-W^{45+} charge states, it is necessary to consider the effect of IPD including the comparison of different electron temperatures and low to medium charge states of W ions.

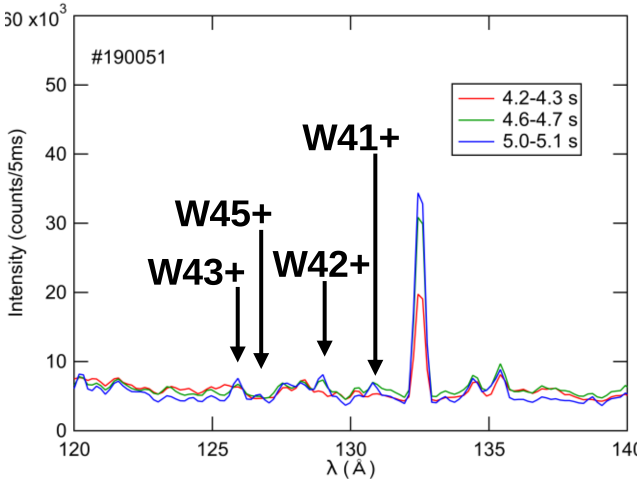


- #190047 w/o IPD
- W pellet @ 3.9 s
- n_e before pellet injection ~ 4 x 10^{13}cm^{-3}





- #190051 w/ IPD ~4-5 s
- W pellet @ 3.9 s
- n_e before pellet injection ~ 4 x 10^{13}cm^{-3}



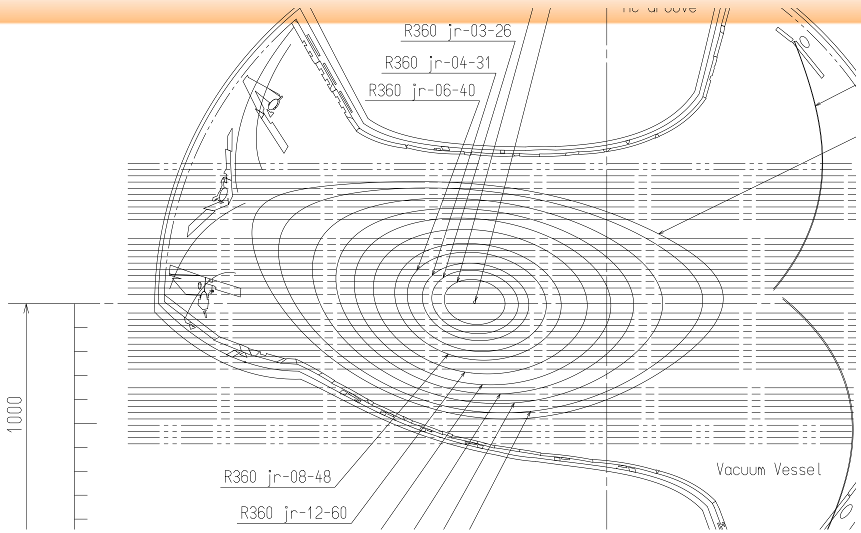
Spectroscopic analysis of divertor detachment

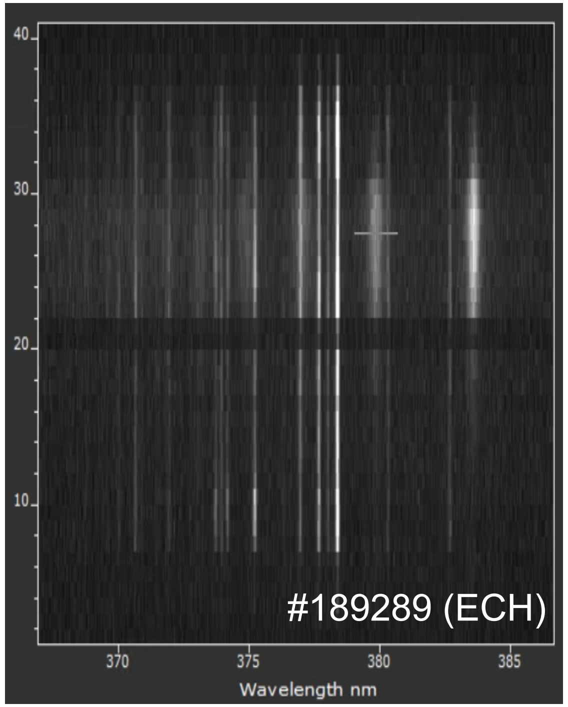
M. Goto and M. Kobayashi

Experimental conditions:
(R_{ax}, Polarity, B_t, γ, B_q) = (3.9 m, CW, 2.538 T, 1.2538, 100%)
LID: 3000 A (6-O)   #190070-#190089

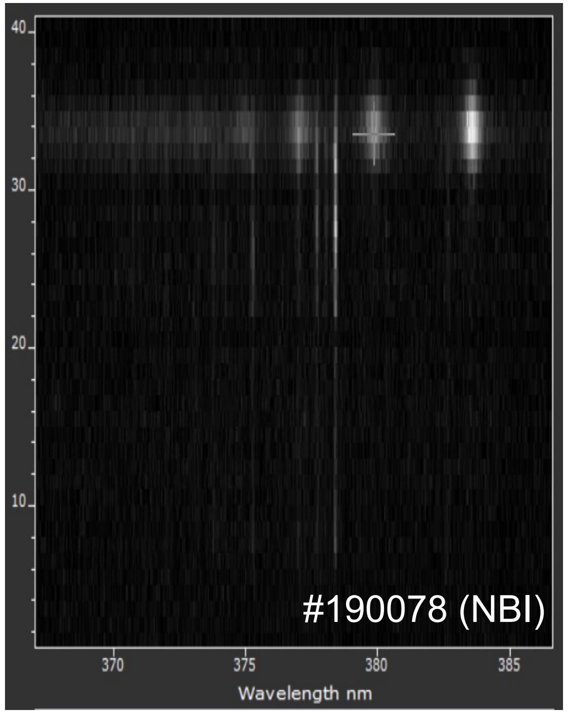
Motivation and method:
- The Balmer series spectrum shows typical recombining plasma characteristics when plasma is detached due to strong hydrogen gas puff.
- Spectrum for NBI plasma is compared with that for ECH plasma on April 10.

Results:
- Spectra also suggest a formation of the recombining plasma for NBI plasmas.
- The recombining plasma formation takes place at different regions for ECH and NBI plasmas.





#189289 (ECH)



#190078 (NBI)

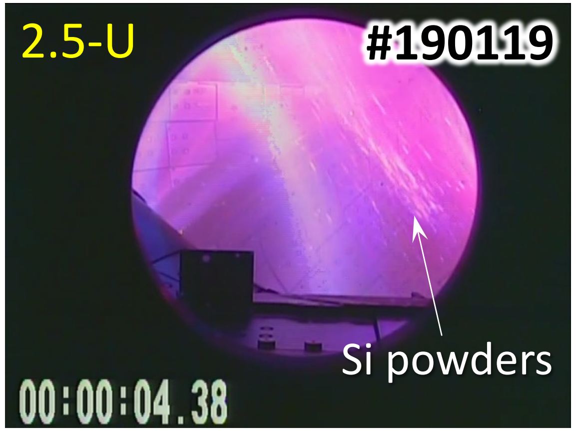
The sustainment of divertor detachment by injection of impurity dust particles into the magnetic island in the LHD peripheral plasma using the IPD

(M. Shoji)

Experimental conditions:

(R_{ax}, Polarity, B_t, γ, B_q) = (3.90 m, CW, 1.375 T, 1.2538, 100%), Shots: #190091 - #190121
I_{LID}=(6O, -1950 A), Shots: #190093 - #190110, I_{LID}=(6O, -3300 A), Shots: #190113 - #190121
ECH: only for start-up, NBI: #1-5, IPD: Silicon (4-5 sec.)

Ablation image of Si powders



Objective:

Triggering and sustaining divertor detachment were tried by enhancing the radiation power induced by the injection of dust particles (silicon and boron) into a magnetic island in the LHD peripheral plasma, which is for assisting the divertor detachment using the IPD.

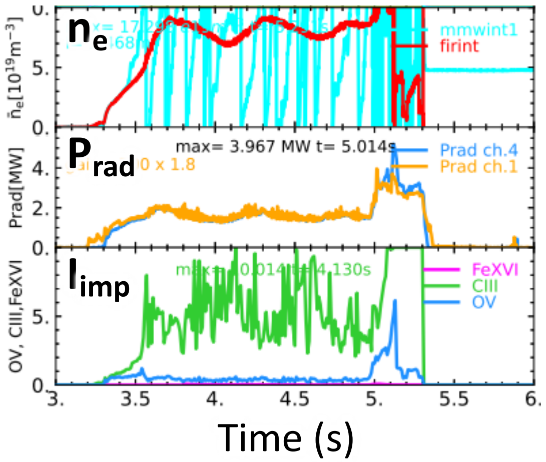
Experiment:

Silicon powders (higher Z) were dropped into the peripheral plasma (magnetic island) by the impurity powder dropper (IPD) in high density plasma discharges ($n_e \sim 6 \times 10^{19}$ m^{-3}) for a low magnetic field (B=1.375 T). The powder drop rate was optimized step by step. Powder injection into plasma discharges with an expanded magnetic island (I_{LID}=-3300 A) were also tried.

Results:

The detached state was achieved at the startup phase of the plasma discharge (~3.5 s). The silicon powder injection contributed to the slight enhancement of the radiation power, which was quite smaller than what was originally expected.

#190115
Without IPD (Si)
With I_{LID} (-3300A)



#190119
With IPD (Si)
With I_{LID} (-3300A)