

# (TG1) Multi-ion Plasma group report



Date: Sep. 30, 2022

Oct. 4, 2022 (N. Tamura)

Time: 11:14 – 15:27

Shot#: 179408 – 179478 (128 shots)

Prior wall conditioning: None

Divertor pump: Off

Gas puff: H<sub>2</sub>

Pellet: None

NBI#(1, 2, 3, 4, 5) = gas(H, H, -, H, H) = P(3.7, 3.2, -, 3.3, 4.1) MW

ECH(56GHz) = ant(1.5U) = P(0.290) MW

ECH(77GHz) = ant(1.5-U<sub>o</sub>, 5.5-U, 2-OUR) = P(0.330, -, 0.365) MW

ECH(154GHz) = ant(2-OLL, 2-OUL, 2-OLR) = P(0.296, 0.364, 0.343) MW

ICH(38.47MHz) = ant(3.5U, 3.5L, 4.5U, 4.5L) = P(0.9, 0.9, 0.9, -) MW

Neutron yield integrated over the experiment =  $6.4 \times 10^{12}$

## Topics

1. Plasma/Device Commissioning (N. Tamura, and others)
2. Commissioning at a low-field (1.375 T) configuration (N. Tamura and others)
3. Commissioning of 56 GHz ECH (R. Yanai)

# Plasma Commissioning (N. Tamura et al. )

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## Experimental conditions: ( $R_{ax}$ , Polarity, $B_t$ , $\gamma$ , $B_q$ ) =

(3.60 m, CCW, 2.75 T, 1.2538, 100.0%): #179408 - #179441

(3.60 m, CCW, 1.375 T, 1.2538, 100.0%): #179442 - #179460

(3.60 m, CCW, 1.000 T, 1.2538, 100.0%): #179461 - #179478

## Goal of this experiment (Continued):

- To confirm the plasma startup and the stable sustainment of the plasmas
- To confirm the operation of diagnostics, data collection/display system, each heating device (ECH, ICH, and NBI)

## Results:

### 3.6m/2.750T

- Commissioning: Feedback control of impurity puff & ECH injection for detachment sustainment → M. Kobayashi
- Commissioning: alpha particle detector for the TAE pB11 experiment → S. Ohdachi (TG4)

### 3.6m/1.375T

- Commissioning: ICRF heating system at  $B_{ax} = 1.375$  T with H plasmas → H. Kasahara
- We have confirmed **the stable sustainment of the ECH + tang.-NBI heated plasmas even at low-field configuration**  
→ **Plasma commissioning is almost done successfully!**

### 3.6m/1.000T

- Commissioning: 56 GHz ECH → R. Yanai

# ICRF heating system commissioning for $B_{ax}$ of 1.375T with H plasmas

H. Kasahara

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**Shot #:** 179422 - 179460

**Experimental conditions:** ( $R_{ax}$ , Polarity,  $B_t$ ,  $\gamma$ ,  $B_q$ ) = (3.60 m, CCW, 1.375 T, 1.2538, 100.0%)

## **Purpose:**

- Confirming the impact between ICRF antennas and plasmas for NBI(H) + ECH plasma.
- Conditioning the ICRF antenna with incoming high-power electromagnetic waves in low magnetic field strength.

## **Experimental result:**

- No antenna impact was observed at the three different antenna distances between antennas and plasma ( $\Delta = 8, 10, 12\text{cm}$ ).
- When the injection power of ICH was 2.7 MW, rapid increases in density, radiation, and carbon line intensity were observed during ICH. Three different injection powers for ICH were conducted, and the increase in emission appeared at the maximum power, while no such phenomenon was observed at powers of 1.8 MW or lower. The 3.5-port and 4.5-port antennas were also compared with power of 0.9 MW, but there were no increases in impurity and radiation.
- The ICH injection time is currently still about 1 s with 0.9 MW in each strap, but we would like to extend the pulse width and promote conditioning in the future. We would also like to confirm the pump assist system, which is a support program for real-time stub control.

# Commissioning: Feedback control of impurity puff & ECH injection for detachment sustainment

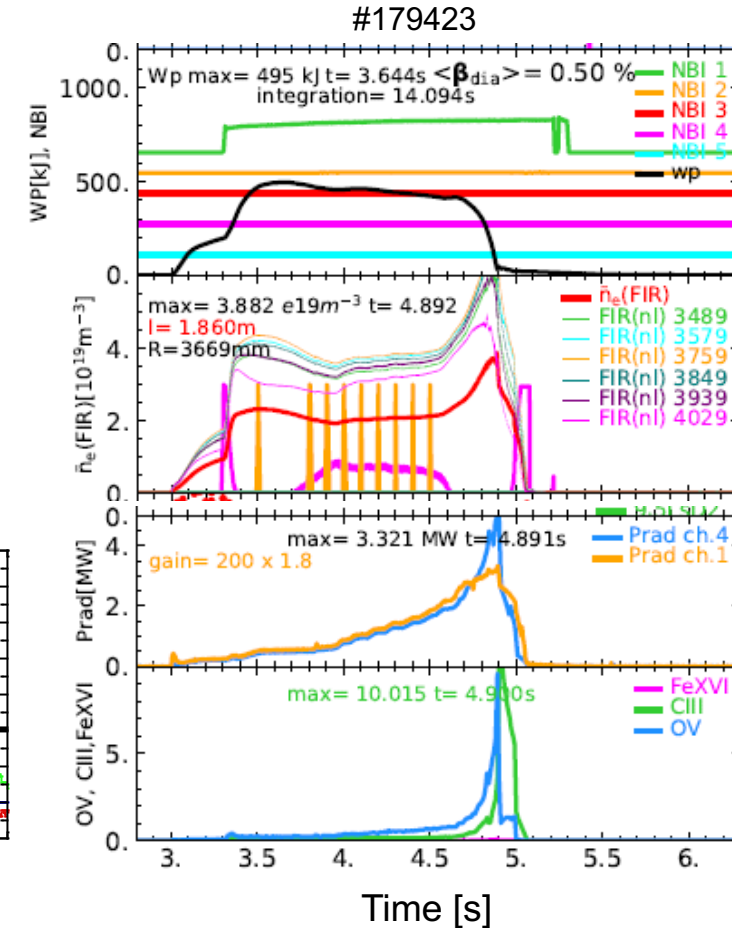
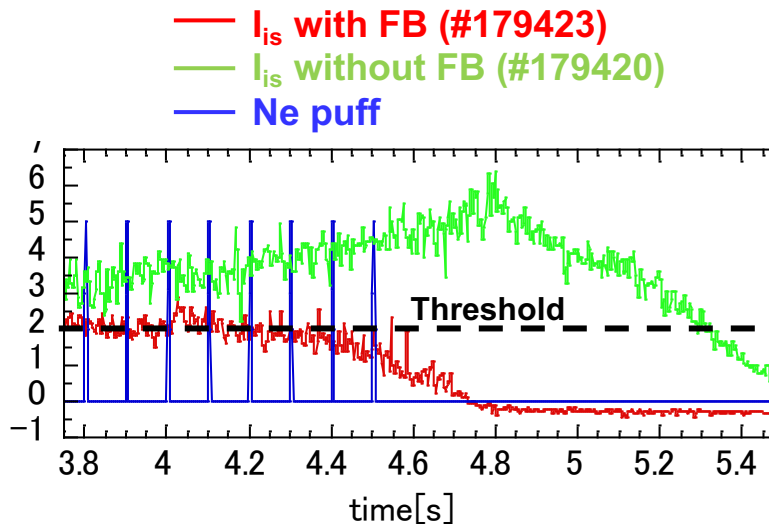
M. Kobayashi, Y. Hayashi, S. Masuzaki

## Background & objectives:

Feedback control system of detachment is being upgraded to use divertor probe signal as an input parameter in stead of a bolometer signal. This is motivated by the experiments in last year with detachment feedback control by bolometer signal, where the higher radiation was hindered. In the present experiment, performance of the system is tested.

## Results:

The divertor probe signal was processed in real-time with FPGA to extract ion saturation current ( $i_{is}$ ) from probe characteristics. Ne was injected with 10Hz of 5ms pulse until  $i_{is}$  decreases below a threshold (2V). A correct behavior was confirmed for the gas puff system. In the ECH system, a bug was found, which will be fixed by the next experiments.



## Acknowledgements:

We would like to thank Mr. K. Nagahara & Y. Mizuno for the support of the preparation of the systems.

**Experimental conditions:**  $(R_{ax}, B_t, \gamma, B_q) = (3.6 \text{ m}, -1 \text{ T}, 1.2538, 100.0\%)$

- Plasma could start up by injecting 56 GHz ECH and two tangential NBIs simultaneously. On the other hand, plasma could not start up injecting the ECH 0.1 s earlier than NBIs.
- We did not try plasma initiation by only NBIs in this time.
- This may be caused by the misalignment of ECH.
- We will try to examine the antenna direction and polarization next time.

