

(TG1) Multi-ion group report



Oct. 6, 2022 (M. Kobayashi)

Date: Oct. 5, 2022

Time: 10:15 -13:40, 17:10 – 18:45

Shot#: 179701 – 179766, 179827 - 179857 (97 shots)

Prior wall conditioning: No

Divertor pump: Off

Gas puff: H₂, He, Ne, N, Ar IPD: B

LID: On

NBI#(1, 2, 3, 4, 5)=gas(H, H, -, H, H)=P(3.5, 3.9, -, 3.8, 4.3) MW

ECH(77GHz)=ant(5.5-U, 2-OUR)=P(703, -)kW

ECH(154GHz)=ant(2-OLL, 2-OUL, 2O-LR)=P(463, 601, 602) kW

ECH(116GHz)=ant(2O-LR)=P(-)kW

ECH(56GHz)=ant(1.5-U)=P(-)kW

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

Neutron yield integrated over the experiment = 8.5×10^{12}

Topics

1. Commissioning, ECH (R. Yanai, M. Nishiura)
2. The evaluation of the toroidal uniformity of the boron deposition on the divertor plates for the real-time boronization using the impurity powder dropper (M. Shoji)
3. Study of poloidal and toroidal asymmetries during impurity seeding in LHD (B. Peterson, K. Mukai)

ECH alignment (R. Yanai and ECH group)

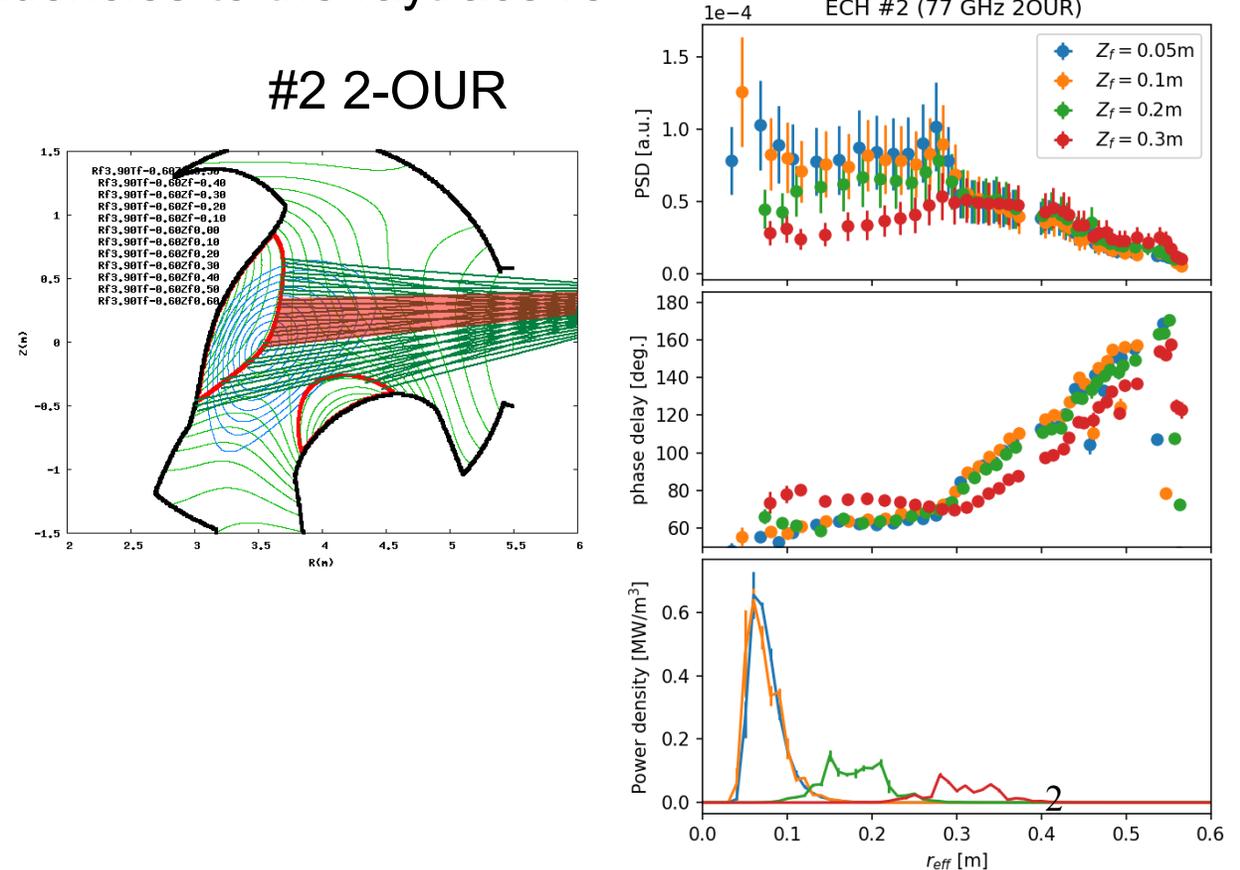
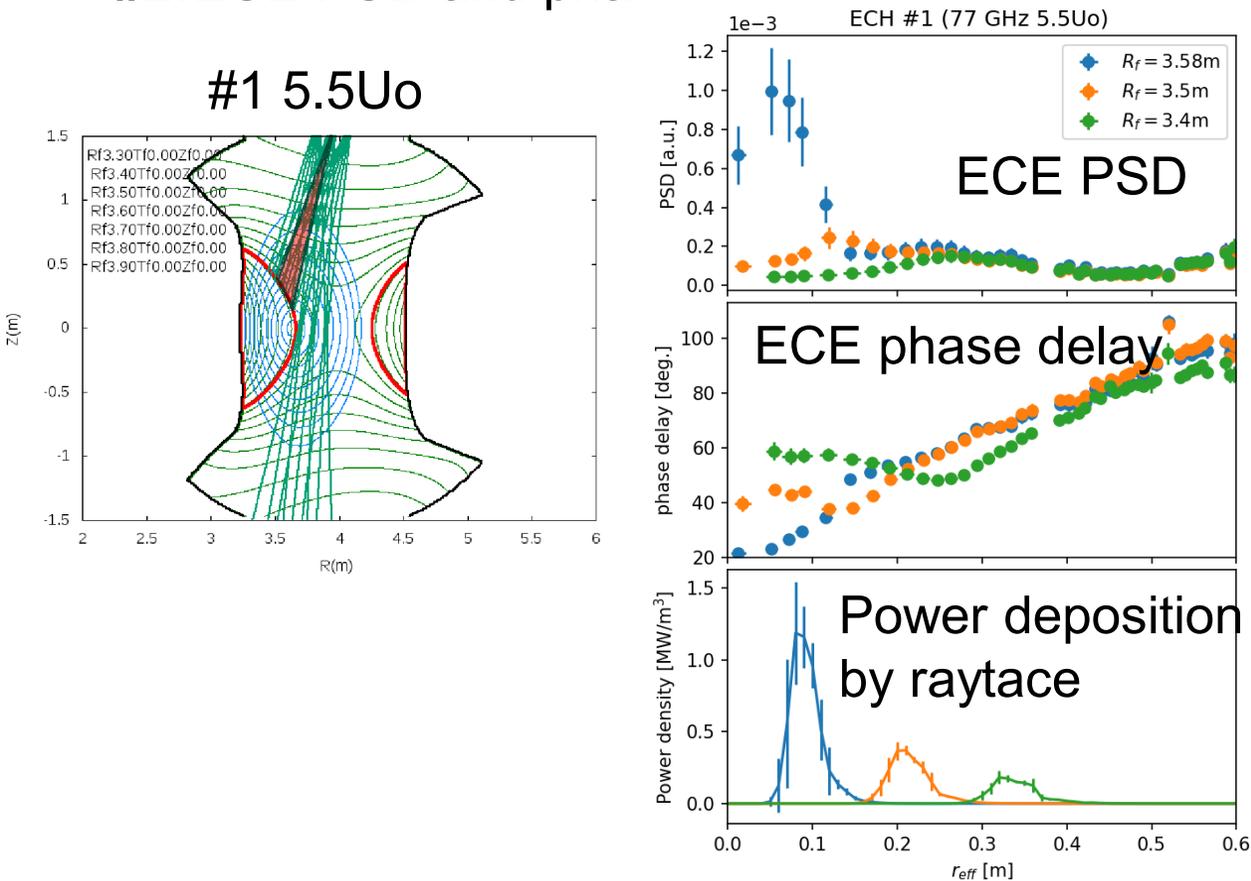
Shot #: 179701 – 179747 (Oct. 5th) and Sep. 29th , Sep. 30th , Oct. 4th

Experimental conditions: $(R_{ax}, \text{Polarity}, B_t, \gamma, B_q) = (3.6 \text{ m}, \text{CCW}, 2.75 \text{ T}, 1.2538, 100 \%)$

Motivation and objective: To confirm ECH alignment and polarization setting.

Results:

- **#1:** PSD and phase delay of ECE agree well with the power deposition calculated by raytrace in the on-axis injection case. The experimental results are slightly different from off-axis injection cases.
- **#2:** ECE PSD and phase delay indicate similar tendencies to the raytrace result

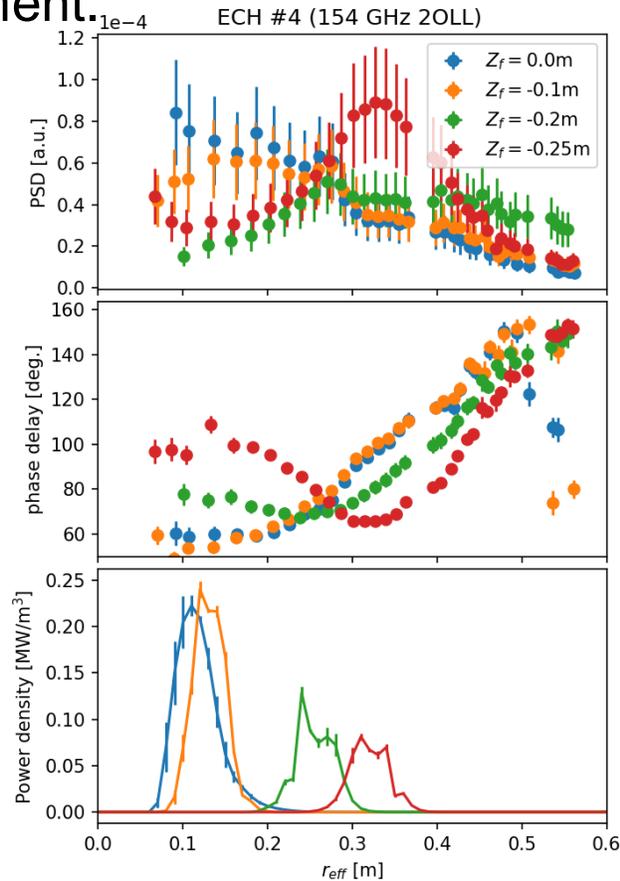
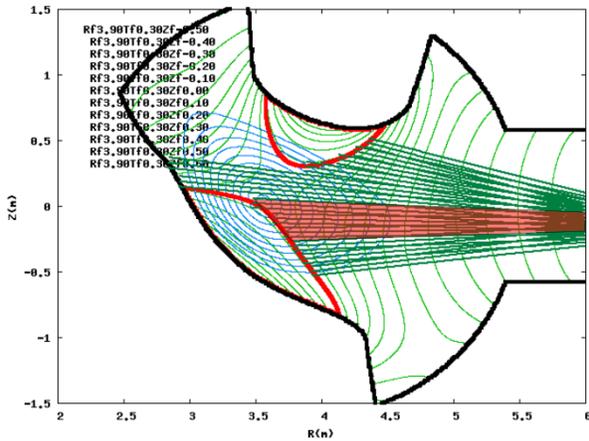


ECH alignment (R. Yanai and ECH group)

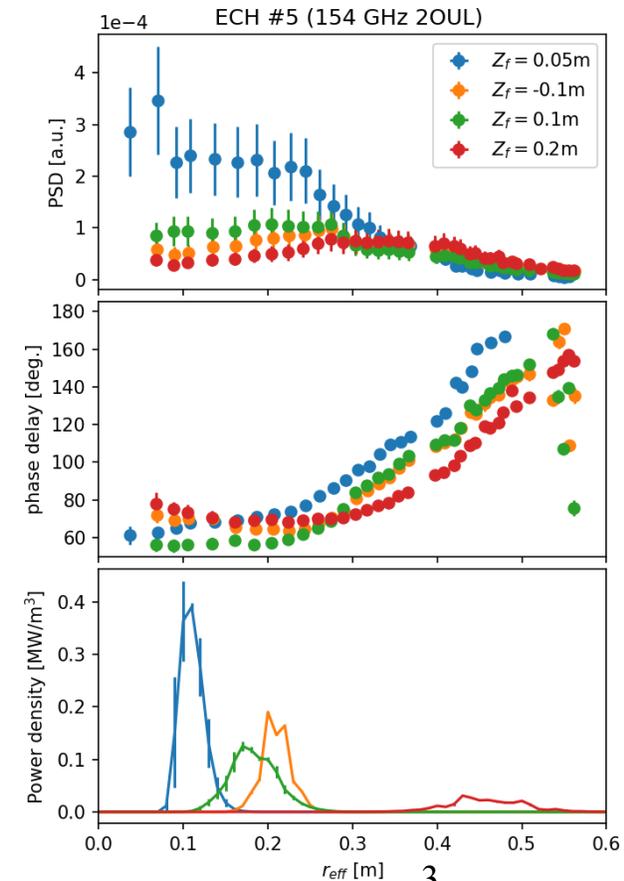
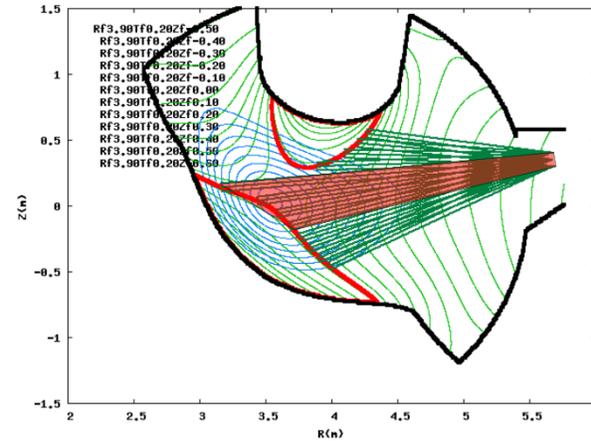
Results:

- **#4:** The experimental results agree pretty well with the raytrace calculations.
- **#5:** The experimental results agree with the raytrace results around $Z_f=0$ but the result at $Z_f=0.2$ m disagrees with the calculation. The shallow angle ECH injection into ECR layer at $Z_f=0.2$ m may enlarge the disagreement.

#4 2-OLL



#5 2-OUL

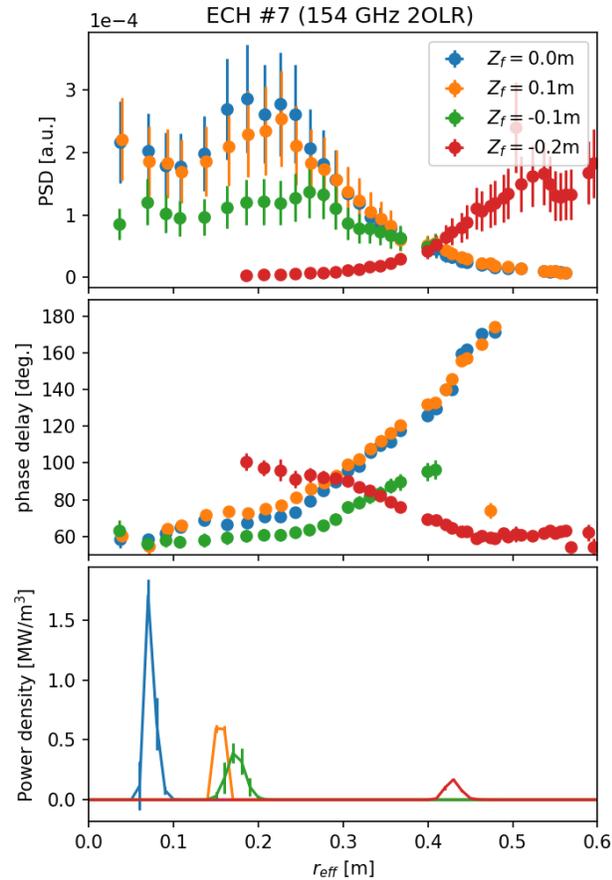
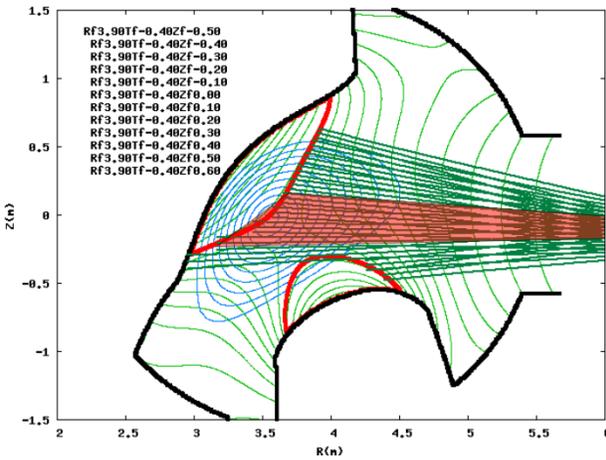


ECH alignment (R. Yanai and ECH group)

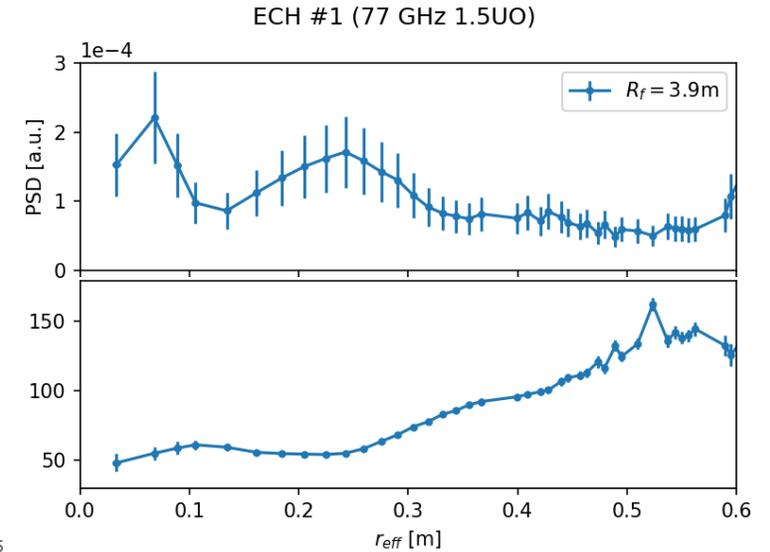
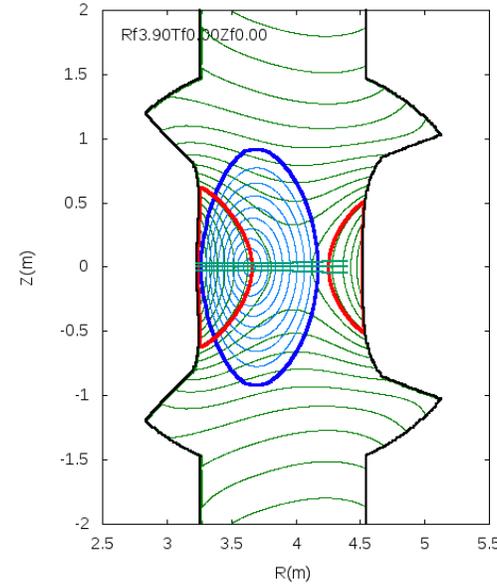
Results:

- **#7:** The experimental results indicate the same tendency as the raytrace calculations but they are slightly different. This may also be caused by shallow angle ECH injection into ECR layer.
- **#1 1.5UO:** PSD is maximized and phase delay is minimized around the on-axis region.

#7 2-OLR

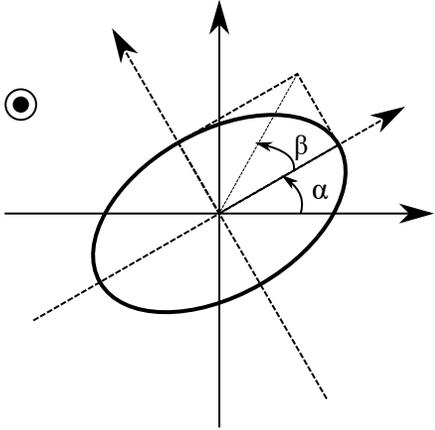


#1 1.5UO

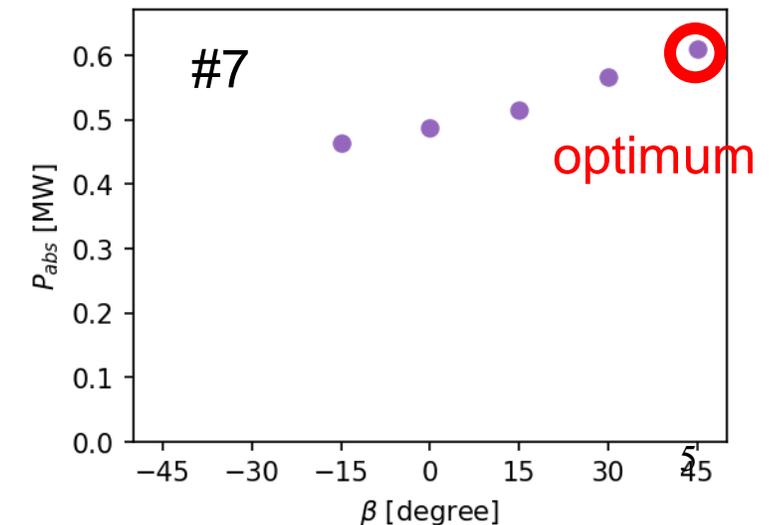
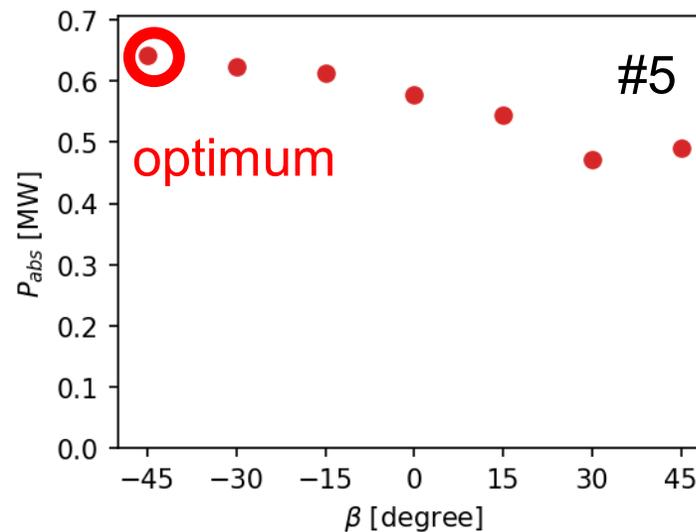
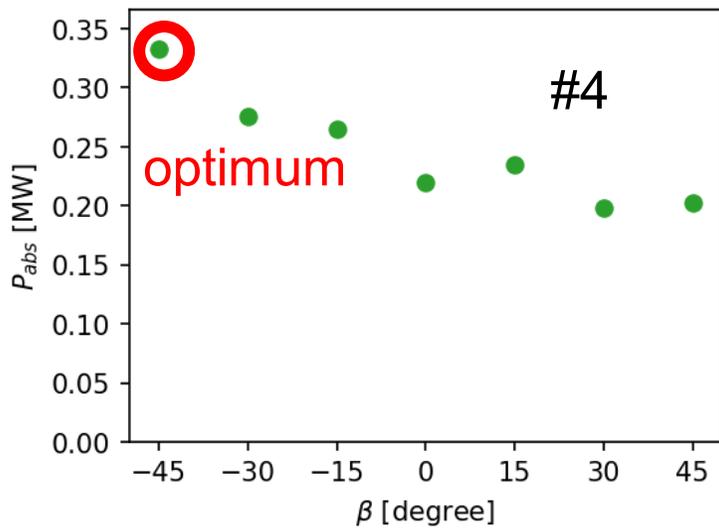
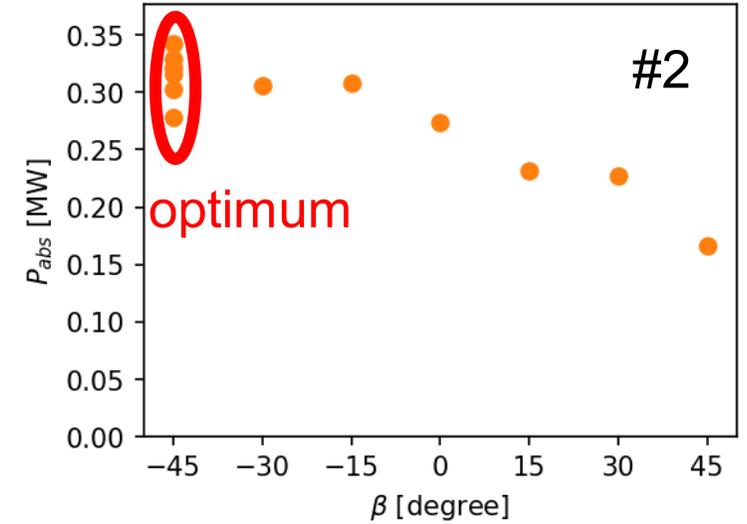
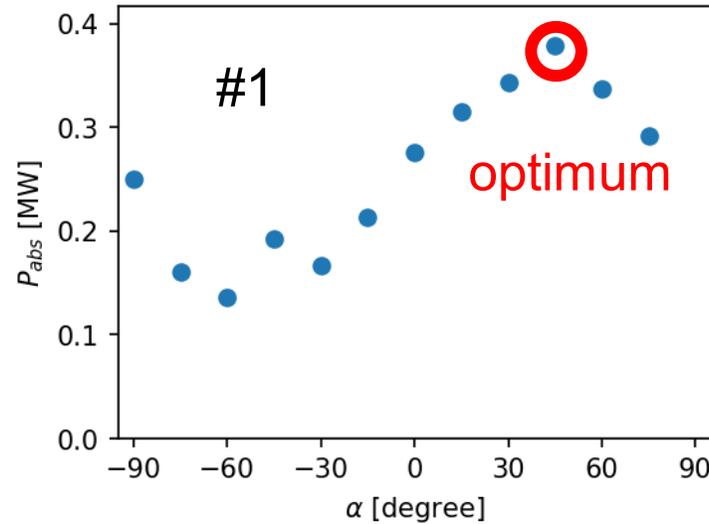


ECH alignment (R. Yanai and ECH group)

Results: Absorbed power are maximized at the optimum polarization setting in all ECH line. There seems to be no problem with the polarization settings.



α : polarization direction
 β : ellipticity



The evaluation of the toroidal uniformity of the boron deposition on the divertor plates for the real-time boronization using the impurity powder dropper (M. Shoji)

- Shot No: #179748~#179766 (5th Oct. 2022)

- Experimental conditions:

(R_{ax} , Polarity, B_t , γ , B_q) = (3.60 m, CW, 2.750 T, 1.2538, 100.0 %), H plasma, IPD: B Powder, $d=150\ \mu\text{m}$ (2.5~4.0 s), NBI: #1, #2, #4, #5 (duration is 2 s), $n_{e,bar}=1.5\sim 2E+19\ \text{m}^{-3}$

- Background and motivation:

- ERO2.0 predicts a more uniform toroidal distribution of boron deposition using the IPD for low plasma density.
- For validating the simulation, the boron deposition density on target plates installed at two toroidal positions is investigated using the 4.5-L and 10.5-L manipulators.

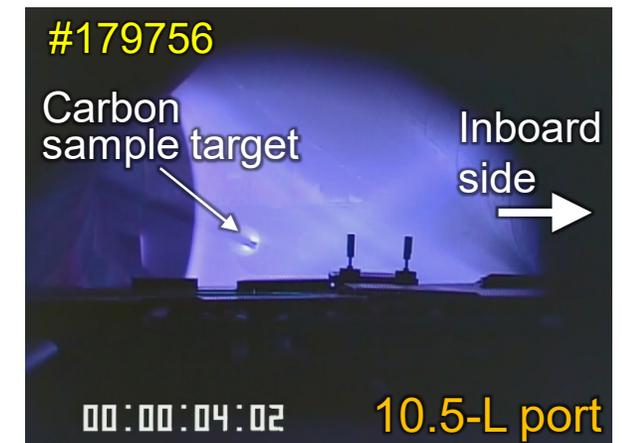
- Preliminary results:

- Strong bright light at the carbon sample targets was observed with visible CCD cameras at during the plasma discharges.
- Radiation collapse frequently occurred by the B powder drop in the middle of the plasma discharges.
- The dependence of the dropping rate of B powders on the vibration voltage was unstable.

Image from 2.5-U



Image from 10.5-U



2022.10.5 Toroidal a/symmetry with N₂ seeding at R_{ax} = 3.75 m, B (CW)

Background and objective:

- Recently bolometers were installed at ports 7-O and 10-O in addition to 3-O, 6.5-L and 8-O.
- N₂ seeding experiments were performed on Jan. 8,19, 2021 at R_{ax} = 3.6 m and -B, B and on October 19, 2021 at R_{ax} = 3.9 m and +B and -B on February 2, 2022 to investigate the toroidal asymmetry of radiation.

Experimental condition:

- NBI #1, 2 (NBI #3 not operational)
- R = 3.75 m, B = 2.64 T
- density is held constant during impurity puff at $n_{e, bar} = 4 \times 10^{19}/m^3$
- LID coil applied every other shot with 6-0 expansion (2350, 1680, 3040 A)

Shots 179827-179857 (31 shots total, ~90 min. of machine time)

- #179830, **31**, **55** : reference shot, no N₂ puff
- #179832, **33** : N₂ puff from port 3.5-L,
- #179834, **41** : N₂ puff from port 5.5-L
- #179836, **37** : N₂ puff from port 9.5-L
- #179844, **50**, **57** : N₂ puff from port 3.5-L, 5.5-L, 9.5-L
- #179852, 54, 56 : Ne puff from port 3.5-L,
- **red** – LID was applied, **bold** = best shot
- # 179846 NBI calibration shot

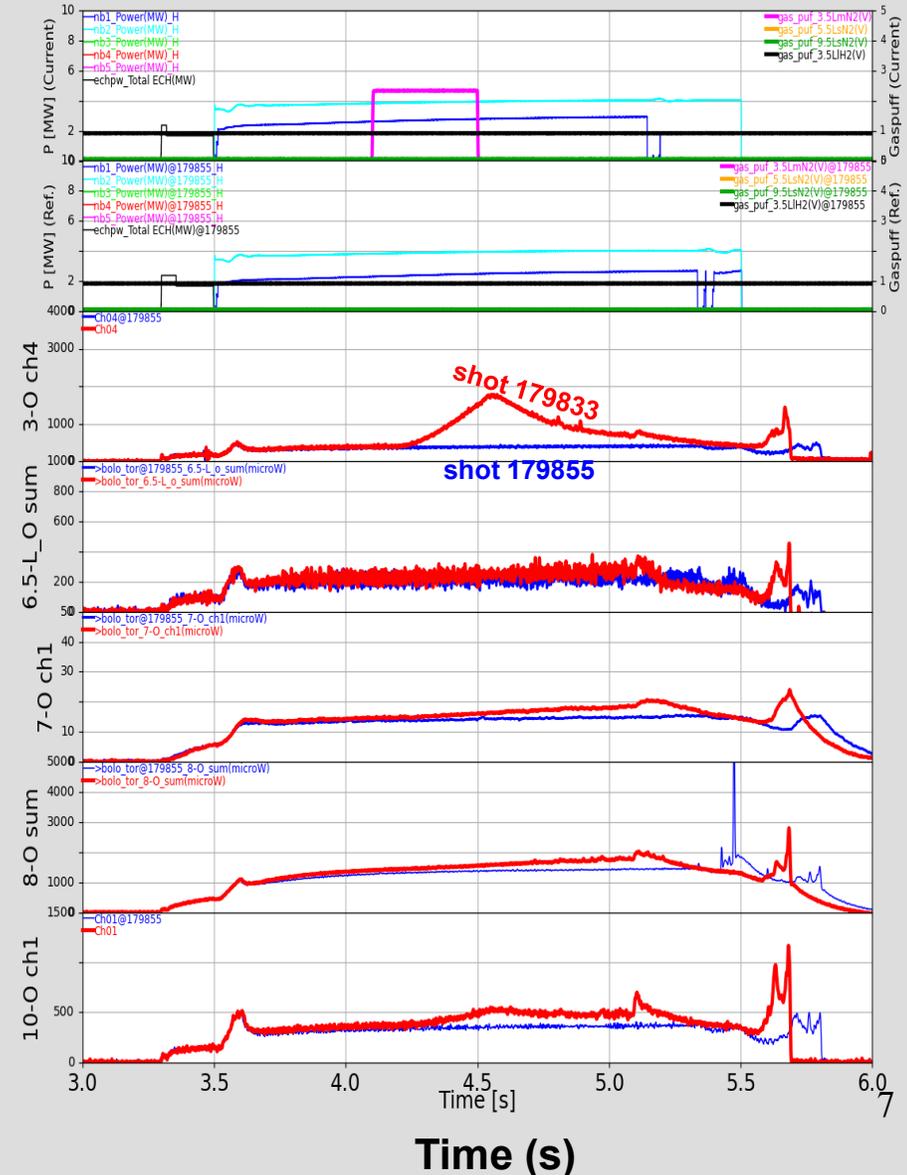
LHD179833

(Rax, gamma, Bq) = (2.64, 3.75, 1.2538, 100)

GAS: H2

2022/10/05 17:26

THEME: [(1) Multi-Ion] Poloidal and toroidal asymmetries of plasma radiation



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- #179852, 54, 56 : Ne puff from port 3.5-L,
- **red** – LID was applied, **bold** = best shot
- # 179846 NBI calibration shot

LHD179836

(Rax, gamma, Bq) = (2.64, 3.75, 1.2538, 100)

GAS: H2

2022/10/05 17:35

THEME: [(1) Multi-Ion] Poloidal and toroidal asymmetries of plasma radiation

