(TG4) Plasma instability group report

Dec. 23, 2021 (K. Nagaoka)

Date: Dec. 22, 2021
Time: 13:20 - 18:45
Shot#: 175773 – 175867 (95 shots)
Prior wall conditioning: None
Divertor pump: On
Gas puff: D2, He, Ne, Ar, Impurity pellet: C
NBI#(1, 2, 3, 4, 5)=gas(H, H, H, D, D)=P(3.2, 3.3, 3.8, 6.8, 6.9)MW
ECH(77GHz)=ant(5.5-Uout (or 1.5U), 2-OUR)=P(703, 792)kW
ECH(154GHz)=ant(2-OLL, 2-OUL , 2-OLR)=P(979, 930, 986)kW
Neutron yield integrated over experiment = 2.3×10^{15}

Topics

1. ECRH/ECCD effects on energetic particle-driven Alfven eigenmodes, (S. Sharapov/K. Ogawa)
2. Divertor detachment by impurity seeding in high-density discharges (Y. Hayashi)
3. Ar seeding experiment (S. Masuzaki)

ECRH/ECCD effects on energetic particle-driven Alfven eigenmodes

S. Sharapov, M. Osakabe, K. Ogawa et al.,

Experimental conditions:

(R_{ax}, Polarity, B_t, γ, B_q)=(3.90 m, CCW, 2.538 T, 1.254, 100%)

(R_{ax}, Polarity, B_t, γ, B_q)=(3.60 m, CCW, 2.75 T, 1.254, 100%)

Background

- Feasibility study for suppressing alpha-driven AEs in a narrow radial ITER region with ECCD.
- The goal is to create the AEs suppression models including tokamaks and helicals.
- In 18th Nov., We performed the co-ECCD, counter-ECCD and ECH in high-B_t configurations. ECCD not only mitigated some modes, but also facilitated some modes.

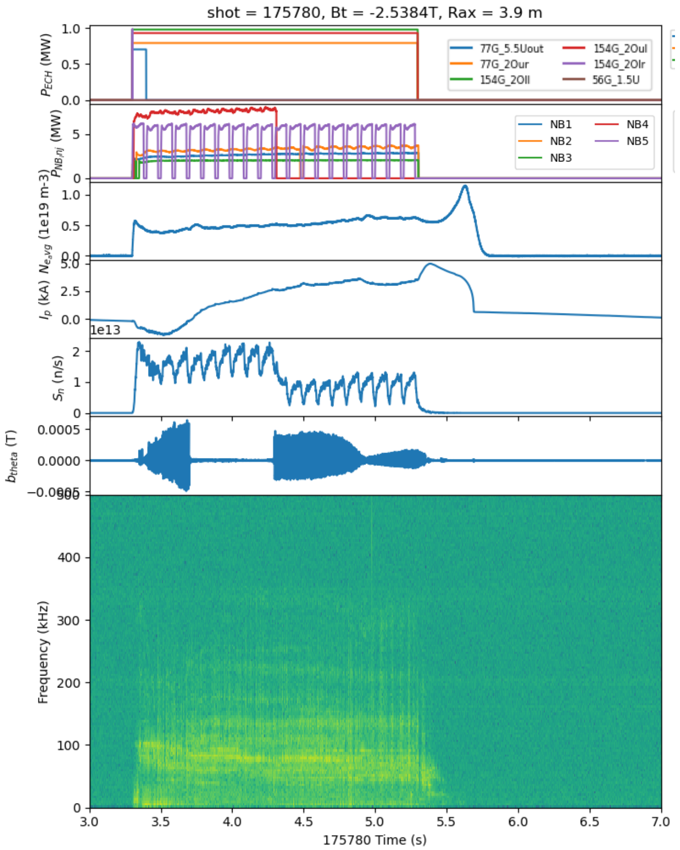
Motivation

- To understand ECCD effect on energetic-ion-driven MHD modes in detail, we need rotational transform profile.

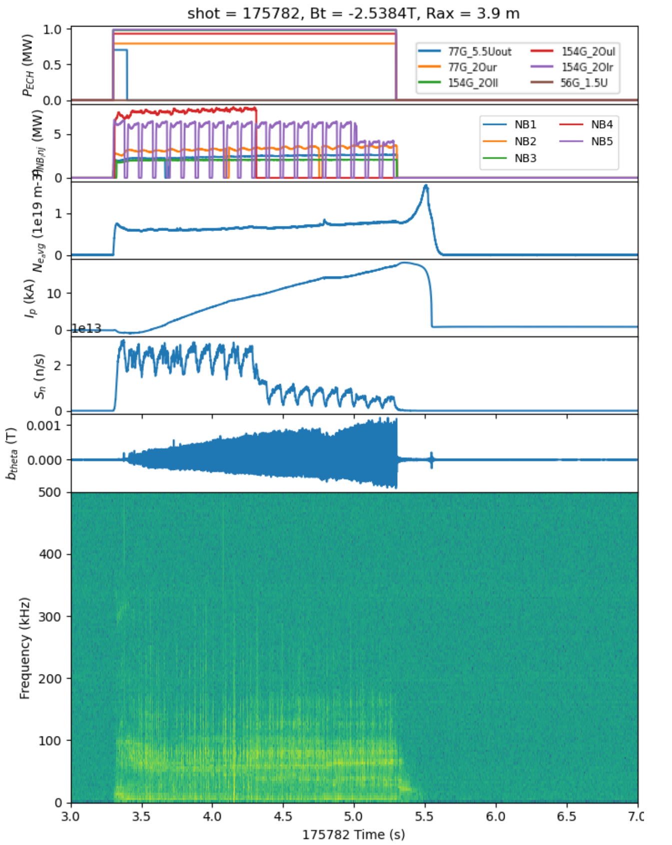
Results

- We performed MSE measurements in ECH and ECCD discharges.
- In addition, deposition position of ECH/ECCD was checked by modulation ECH.
- Rotational transform profile analysis and ECH deposition analysis are ongoing.

ECH discharge



ECCD discharge



Divertor detachment by impurity seeding in high-density discharges

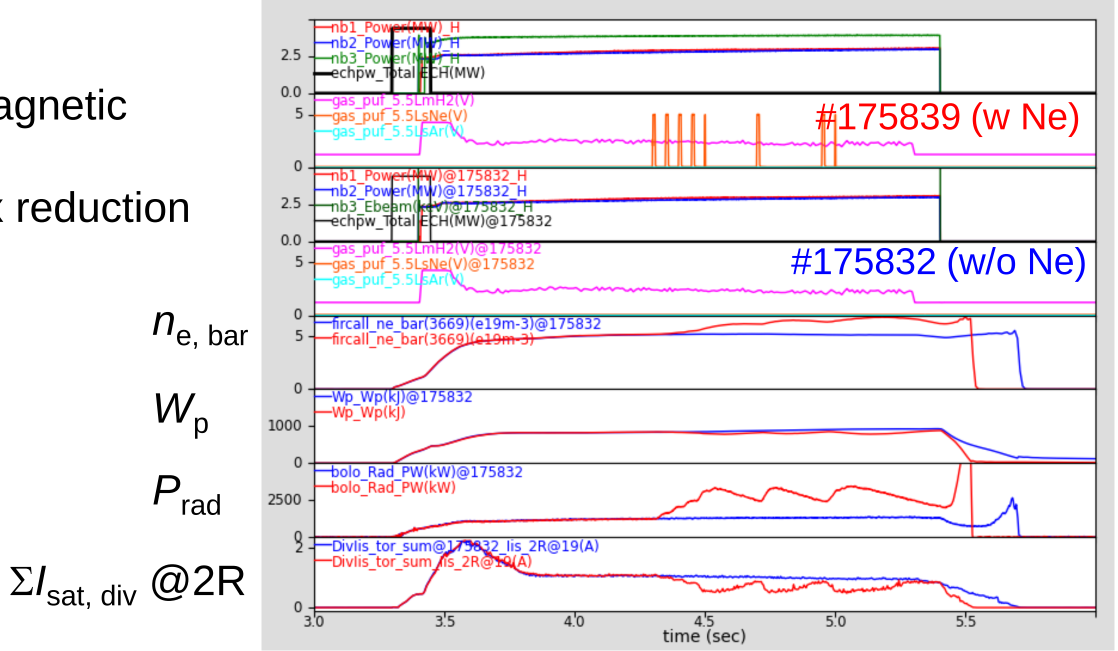
Y. Hayashi, M. Kobayashi, S. Masuzaki

Background and purpose

- There are several heat flux channels at divertor plates in standard magnetic configuration in LHD.
- The purpose is to elucidate the effect of impurity seeding on heat flux reduction at the divertor plates with multi magnetic footprint.

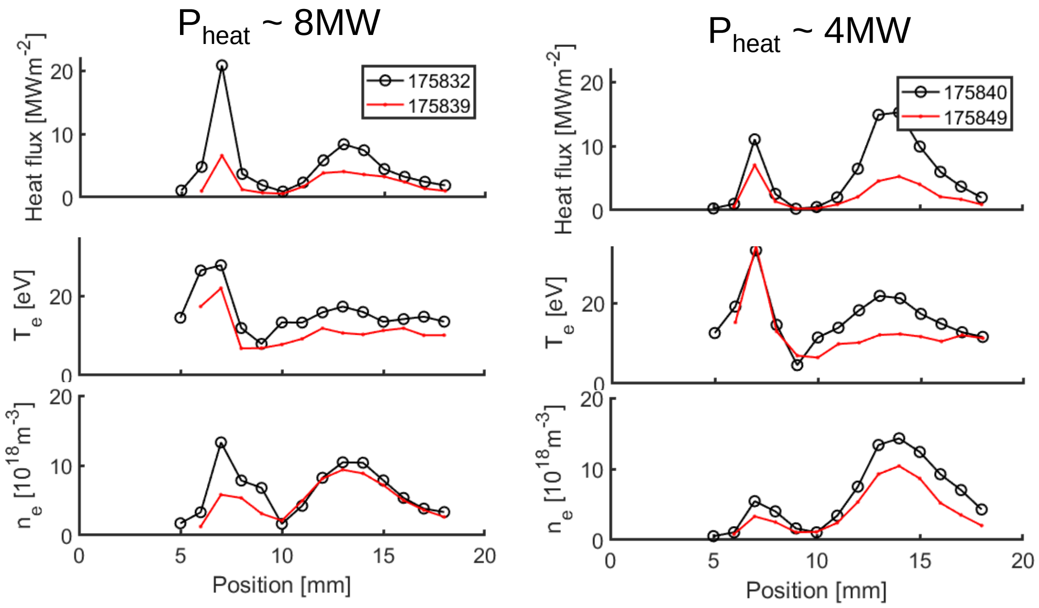
Experimental condition

- #175809 ~ #175856 (48 shots)
- (R_{ax}, B_t, γ, B_q) = (3.60 m, -2.75 T, 1.254, 100%)
- NBI #1-3 ($P_{NBI,\ port}$ ~ 8 MW & 4 MW)
- $n_{e,\ bar}$ ~ 5 x 10^{19} m^{-3}
- Divertor pumping: ON



Results

- Reduction in Ion saturation current could be sustained until end of discharge by feedback control of Ne injection.
- High power case, strong reduction in heat flux at primary strike line was achieved by T_e and n_e reduction, while heat flux at 2nd broad peak decreased only by T_e reduction.
- Low power case, reduction ratio by Ne seeding at 2nd peak was higher than primary strike line.
- T_e at primary strike line in low power case was not affected by impurity seeding.



Ar seeding experiment

S. Masuzaki, Y. Hayashi, M. Kobayashi

Shot #: 175850-175867
(R_{ax}, B_t, γ, B_q) = (3.6 m, -2.75 T, 1.2538, 100.0%)
Working gas: H2
P_{NBI} ~ 11 MW
P_{ECH} ~ 4.5 MW

- ✓ Ar gas was seeded from 5.5L port with feedback-control using bolometer signal.
- ✓ P_{rad} limit for collapse was less than 30% of P_{NBI}.
- ✓ Line averaged density increased with Ar seeding. Density increased in whole region.
- ✓ Electron temperature decreased but not the decrease was not so large.
- ✓ Divertor particle flux decreased by Ar seeding.
- ✓ Zeff increased: 1.7 → 2.4
- ✓ Differences of plasma responses than Ne seeding such as Zeff were observed and will be analyzed.