

# (TG4) Plasma instability group report

Dec. 16, 2022 (Y. Takemura)

Date: Dec. 15, 2022

Time: 9:34 - 14:43, 16:43 - 18:45

Shot#: 186078-186173, 186210-186247 (132 shots)

Prior wall conditioning: Off

Divertor pump: On

Gas puff: H<sub>2</sub>, Pellet: None

NBI#(1, 2, 3, 4, 5)=gas(H, H, H, H, H)=P(2.2, 3.8, 3.7, 4.3, 4.4)MW

ECH(56GHz)=ant(1.5-U)=P(0.29)MW

ECH(77GHz)=ant(5.5-U, 2-OUR)=P(0.70, -)MW

Neutron yield integrated over experiment = (4.8E+13)

## Topics

1. Study of Fast-Ion Stiffness in Alfvén-Eigenmode at Helical Device (S. Kamio)
2. RMP effect on sawtooth-like oscillation (Y. Takemura)
3. Spatial structures of density, electric potential and density fluctuations in the core region during perpendicular NBI (T. Ido, A. Shimizu, M. Nishiura)

# Study of Fast-Ion Stiffness in Alfvén-Eigenmode at Helical Device (S. Kamio)

**Shot #:186078-186108**

**Experimental conditions:**  $(R_{ax}, \text{Polarity}, B_t, \gamma, B_q) = (3.6, \text{CW}, 1.0 \text{ and } 0.75, 1.2538, 100)$ , NBI#(1, 2, 3, 4, 5)=gas(H, H, H, H, H)=P(1.9, 3.8, 3.7, 3.8, 0) MW

## Background and motivation:

- Experiments in the tokamak device showed that fast-ion profile becomes stiff above a critical threshold of fast-ion pressure gradient in the presence of multiple-AEs. In this experiment, we verify that the fast-ion profile stiffness occurs in helical devices with deuterium beams.

## Results:

- We observed the fast-ion distribution with FIDA when tangential-NBI power with deuterium was scanned in the LHD experiment in 1.0 T and 0.75 T with  $1.0$  and  $0.5 \times 10^{19} \text{ m}^{-3}$ .
- We are now carefully comparing the FIDA signals.

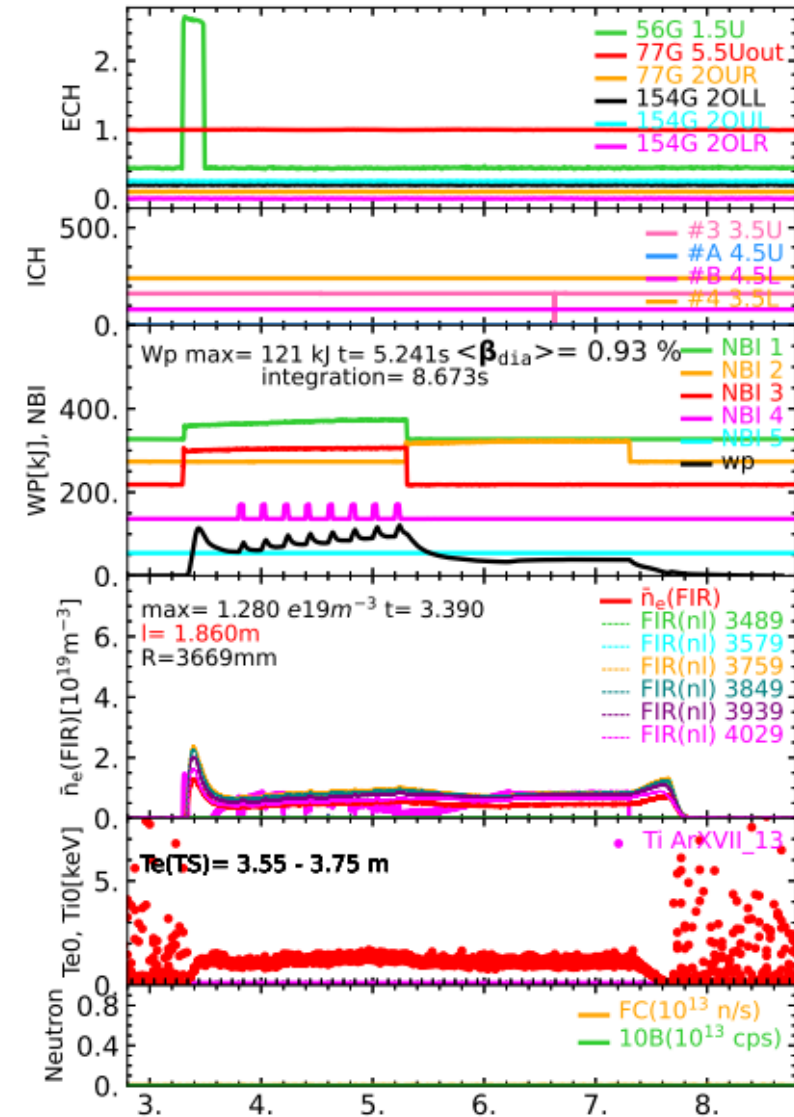


Fig.1 Time evolutions of the typical discharge for fast-ion stiffness experiments.

# RMP effect on sawtooth-like oscillation (Y. Takemura)

Shot #:186110-186173

Experimental conditions:

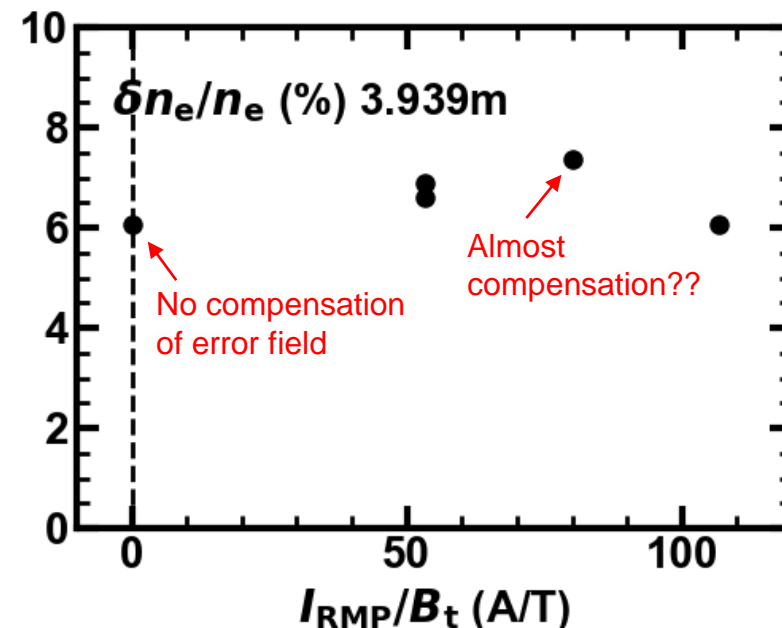
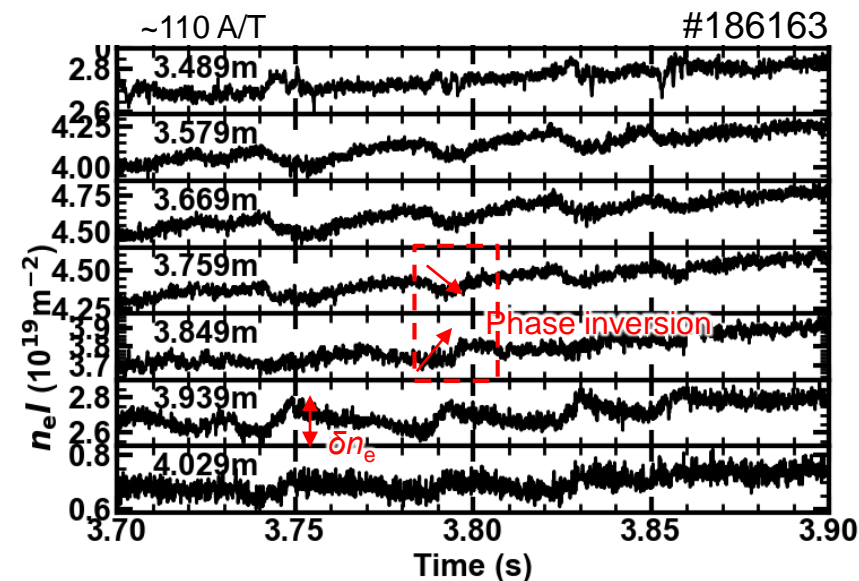
$(R_{ax}, \text{Polarity}, B_t, \gamma, B_q) = (3.6, \text{CW}, 0.75, 1.129, 100)$

Background and motivation:

- Sawtooth-like oscillation is observed in the LHD with high aspect ratio configuration.
  - There is a phase inversion in  $n_e$  profile around  $iota = 1$ .
- In the previous result, it seems that behavior of the instability is different when the error field is canceled by external RMP coils.
- In order to clarify the stabilizing mechanism of the instability, the effect of external RMP on the instability is investigated.

Results:

- When static external RMP of  $I_{RMP}/B_t \sim 80$  A/T is imposed, the  $n_e$  oscillation amplitude is large compared to other RMP conditions.
  - Since the error field is considered to be almost compensated, the error field may have the stabilizing effect of the instability.
- Plasma flow and pressure profile during crush are obtained. The relationship with the instability will be analyzed.



# Spatial structures of density, electric potential and density fluctuations in the core region during perpendicular NBI (T. Ido, A. Shimizu, M. Nishiura)

Shot #: 186210 - 186247

Experimental conditions:  $(R_{ax}, \text{Polarity}, B_t, \gamma, B_q) = (3.75\text{m}, +1.375\text{ T}, 1.254, 100\%)$

## Background and motivation:

- The initial motivation of the experiment is to verify a theoretical study on the influence of energetic trapped particles on the electric fields. (Ref. H.Yamaguchi, IAEA-CN TH/P6-29 (2018)).
- In the last campaign, the response of spatial structures of  $\phi$  and density profiles was observed for NBI#4, not for NBI#5, though  $P_{\text{NBI}\#4} > P_{\text{NBI}\#5}$ . Note that NBI#4 is closer to HIBP than NBI#5.
- The purpose is to verify the toroidal nonuniformity in  $\phi$  and density and to investigate the power, fueling, and the collision-frequency dependence.

## Results:

- Even when  $P_{\text{NBI}\#4} \sim P_{\text{NBI}\#5}$ , the response of spatial structures of density profiles was observed for NBI#4, not for NBI#5. Fluctuation was also observed near core region only in the case of NBI#4.
- Since the electric noise in  $\phi$  signals at 60 Hz was severe, the data should be analyzed carefully.

