(TG4) Plasma instability group report

Dec. 21, 2022 (N. Kenmochi)

Date: Dec.20, 2022
Time: 11:55 -14:45
Shot#: 186548-186598 (51shots)

Prior wall conditioning: No

Divertor pump: On
Gas puff: H2, Ne, Ar Pellet: No
NBI#(1, 2, 3, 4, 5)=gas(H, H, H, H, H)=P(0, 2.0, 2.1, 3.7, 4.0)MW
ECH(77GHz)=ant(5.5-Uout (or 1.5U), 2-OUR)=P(0.70, 0)MW
ECH(154GHz)=ant(2-OLL, 2-OUL, 2-OLR)=P(0, 0, 0)MW
ECH(56GHz)=ant(1.5U)=P(0.0)MW
ICH(3.5U, 3.5L, 4.5U, 4.5L)=P(0, 0, 0, 0)MW
Neutron yield integrated over experiment = 1.9×10^{13}

Topic

1. Optimization of non-collisional energy transfer from energetic ions to bulk ions in reversed magnetic shear plasmas (K. Toi, K. Ogawa)
2. Studies of global stability and transport characteristics of a helical plasma with zero rotational-transform layer produced by non-inductive counter current drive (K. Toi, S. Ohdachi)

Optimization of non-collisional energy transfer from energetic ions to bulk ions in reversed magnetic shear plasmas

K. Toi, K. Ogawa

Background and objective

- Noticeable T_{io}-increase observed in counter NBCD plasmas is interpreted consistently by ion Landau damping of energetic ion driven geodesic acoustic mode (EGAM). The T_{io}-increase is suddenly terminated by sudden drop of EGAM damping rate.
- Main objective is to avoid the sudden termination by applying ECCD and to achieve long sustainment of $T_{io} \gtrsim T_{eo}$ condition.

Experimental condition

- #186549 ~ #186571 (23 shots)
- (R_{ax}, B_t, γ, B_q) = (3.75 m, 1.3 & 1.5T, 1.254, 100%)
- NBI #3 ($P_{NBI,\ port}$ ~ 2.1 MW), modulated ECH (averaged ~0.35MW) fo some shots.
- $n_{e,\ bar}$ ~ 0.2-1.0x 10^{19} m^{-3}
- Divertor pumping: ON
- Gas: Ne (for high NB-driven current) , Ar (for Crystal spectroscopy)

Results

- $T_{io} \gtrsim T_{eo}$ plasma condition obtained in the 23th campaign was not reproduced due to too low plasma current driven by #3 NBI alone. In this campaign, obtained highest plasma current is ~ 82 kA, where obviously T_{io} is lower than T_{eo} as seen from Fig.1. Even in this low Ip shot, a reversed magnetic shear plasma is produced and a signature of Tio-increase quench is found as a jump of EGAM amplitude.
- Modulated ECH was tested in low current plasmas instead of ECCD (ECCD was not available this day).

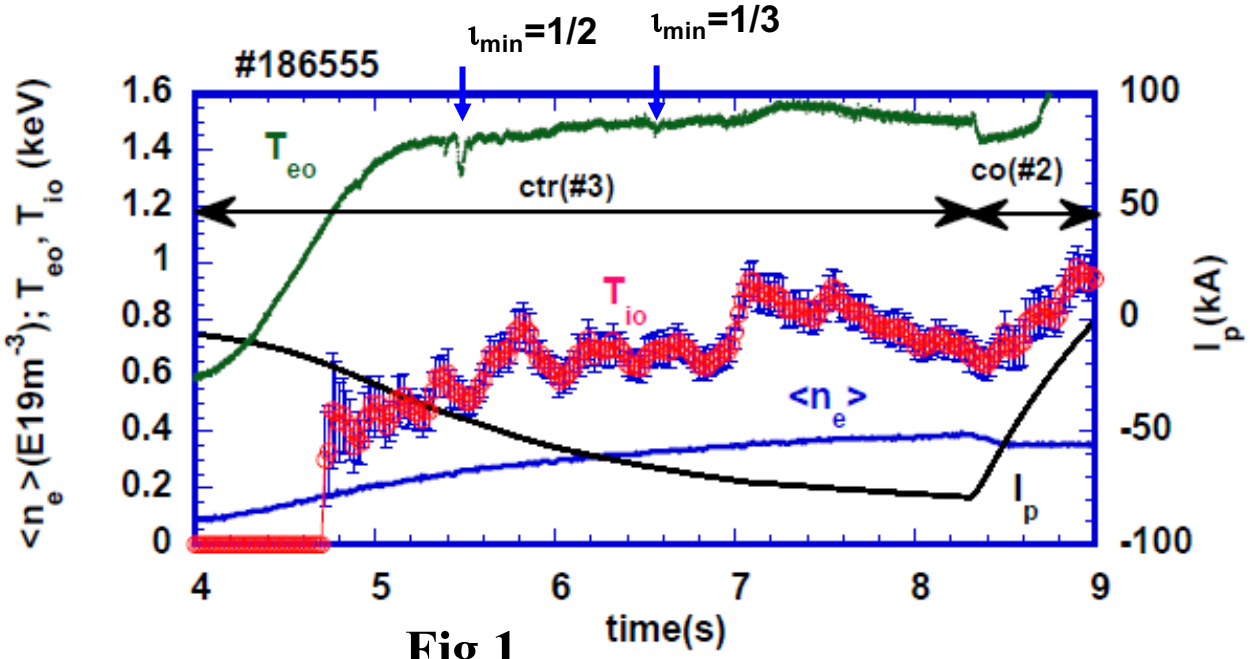

Fig.1

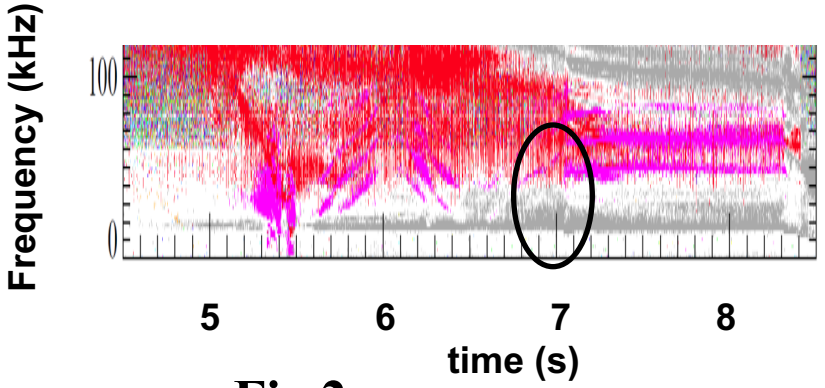

Fig.2

Studies of global stability and transport characteristics of a helical plasma with zero rotational-transform layer produced by non-inductive counter current drive

K. Toi, S. Ohdachi

Background and objective

- To produce very low rotational transform in plasma core region by counter NBCD up to -150 kA to simulate *tokamak current hole*-like plasma
- Objective is to clarify responses of plasma profiles (Te, ne, Ti) and plasma flows to very low ι in the plasma core region, and to investigate formation of n=0 magnetic island, current clamping and so on.

Experimental condition

- #186572 ~ #186598 (27 shots)
- (R_{ax}, B_t, γ, B_q) = (3.60 m, 1.5 & 1.3T, 1.254, 100%)
- NBI #3 ($P_{NBI,\ port}$ ~ 2.1 MW), NBI #4 & #5 were injected for some shots.
- $n_{e,\ bar}$ ~ 0.2 – 1.0x 10^{19} m^{-3}
- Divertor pumping: ON
- Gas: Ne (for high NB-driven current) , Ar (for Crystal spectroscopy)

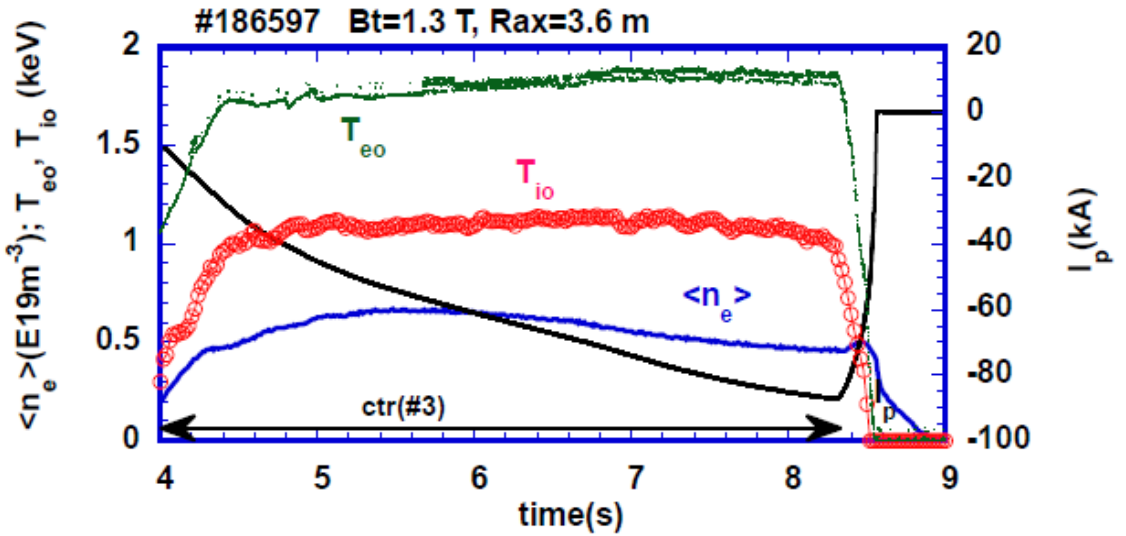

Fig.1

Results

- Target plasmas having high toroidal current (~130-150 kA) achieved in the past campaign was not obtained due to low tangential beam power (only #3 NBI). On this condition, obtained highest plasma current is ~ 87 kA (Fig.1), despite of careful tuning of plasma condition. We will study temporal evolution of the central rotational transform with help of characteristic Alfven eigenmode activities observed in the past campaign.

- T_e profile at Ip~ -87 kA (at t=8.0669 s) is parabolic as shown in Fig.2 and seems to have no signature inferred for very low rotational transform near the plasma center.

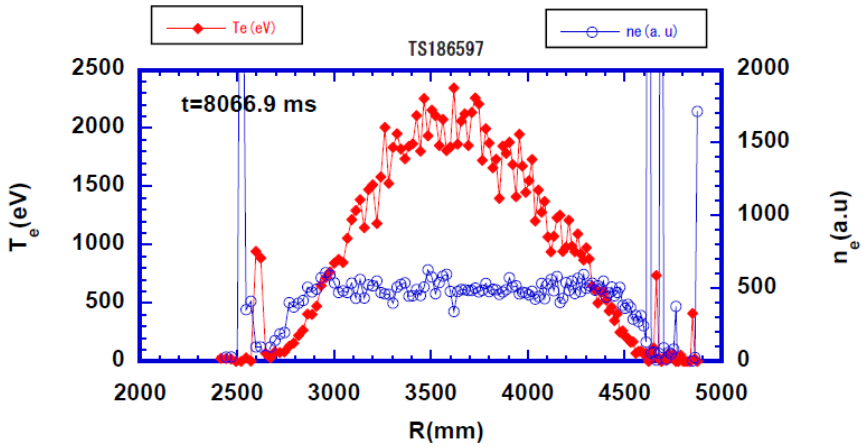

Fig.2