(IA) Session Report

June 11, 2024 (H. Funaba)

Date: June 7, 2024
Time: 10:25 – 16:45
Shot#: 192843– 192928 (86 shots)
Prior wall conditioning: No
Divertor pump: Off
Gas puff: H_2
Pellet: No

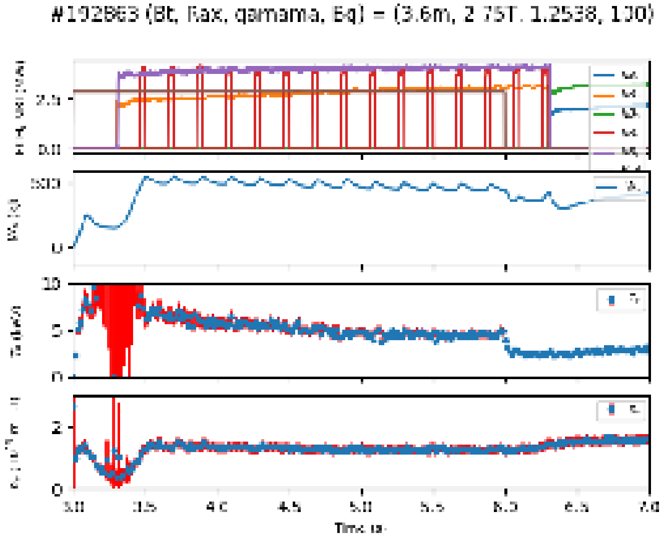
NBI#(1, 2, 3, 4, 5) = gas(H, H, H, H, H)=P(4.6,2.9, 3.2, 3.5, 2.8) MW
ECH(77GHz) = ant(1.5-Uo, 5.5-U, 2-OUR)=P(-, 0.698, 0.380) MW
ECH(154GHz) = ant(2-OLL, 2-OUL, 2-OLR)=P(0.705, 0.806, 0.982) MW
ECH(116GHz) = ant(2-OLR)=P(0.629) MW
ICH(3.5U, 3.5L, 4.5U, 4.5L) = P(-, -, -, -) MW

Topics

1. Development of C-ECE for measuring temperature fluctuation inside/outside e-ITB (M. Gong (U. Tokyo), M. Nishiura))
2. MHD instability suppression by RMP field (S. Ito, K.Y. Watanabe)
3. Plasma shape effect on bootstrap current in high collisional regime in LHD (O. Mitarai, K.Y. Watanabe)

Development of C-ECE for measuring temperature fluctuation inside/outside e-ITB

(M. Gong, M. Nishiura, R. Yanai, K. Ueda)

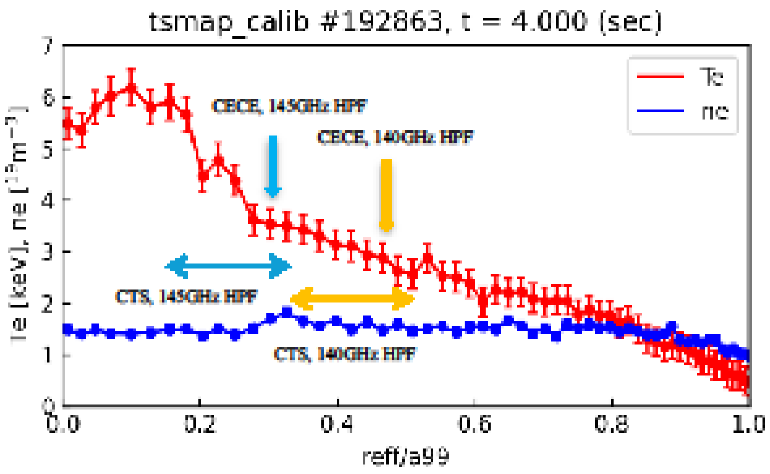


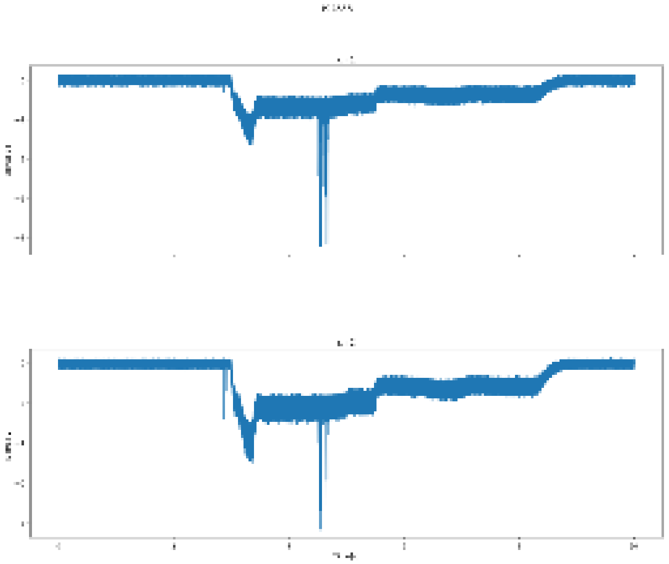
Experimental conditions: (R_{ax}, Polarity, B_t, γ, B_q) = (2.75 T, 3.6 m, 1.2538, 100%)

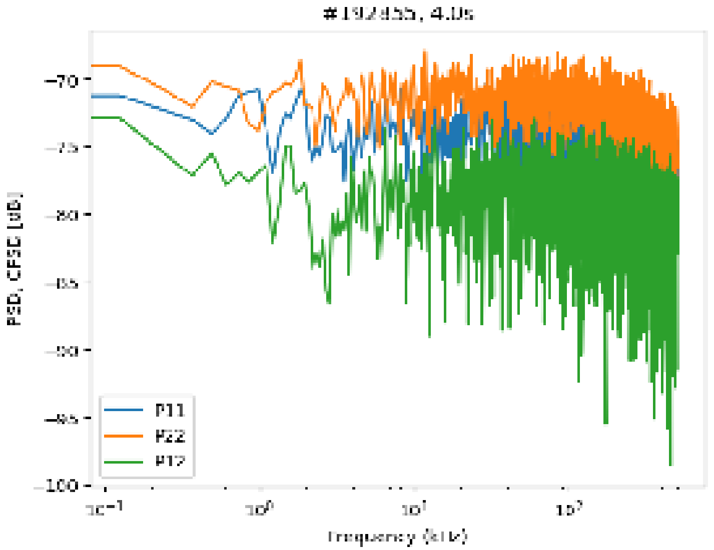
Motivation: We are developing a new C-ECE system for measuring temperature fluctuation in LHD. In this experiment, we propose to measure electron temperature fluctuation in electron internal transport barrier (eITB) type plasma to obtain a radial profile of electron temperature fluctuation for understanding the heat transport inside and outside eITB.

Method & Results:

- CTS receiver and a newly developed CECE system is applied for detecting the temperature fluctuation in LHD plasma. The measurement position of CTS and CECE receiver are given by the ray-trace calculation results.
- HIBP is employed to measure the fluctuation at rho ~0.2 & 0.4.
- e-ITB type plasma is produced, temperature fluctuation information is under investigation by cross-correlating CECE channels.







Resistive Interchange Instability suppression by Ext.-RMP (S.Ito[, K.Y.Watanabe])

Background and motivation:

According to our previous work, RIC (Resistive InterChange) instability is known to be suppreseed by external RMP, and the empirical scaling law of ext. RMP amplitude to suppress the RIC completely was found as the following;

"Ext.-RMP amplitude to completely suppress RIC"

$$= \mathbf{2.3 \times 10^3} \cdot \boldsymbol{\beta}^{\mathbf{1.8}} \cdot \boldsymbol{\nu}_*^{\mathbf{0.24}} \cdot \boldsymbol{\rho}_*^{\mathbf{0.85}}$$

However, the exponent of β and ν* would not be accurate because the data, we used for our analysis, has high correlation between β and ν*. Now, we get the additional dataset to decrease the correlation between β and ν* to improve accuracy of the above scaling on β and ν*.

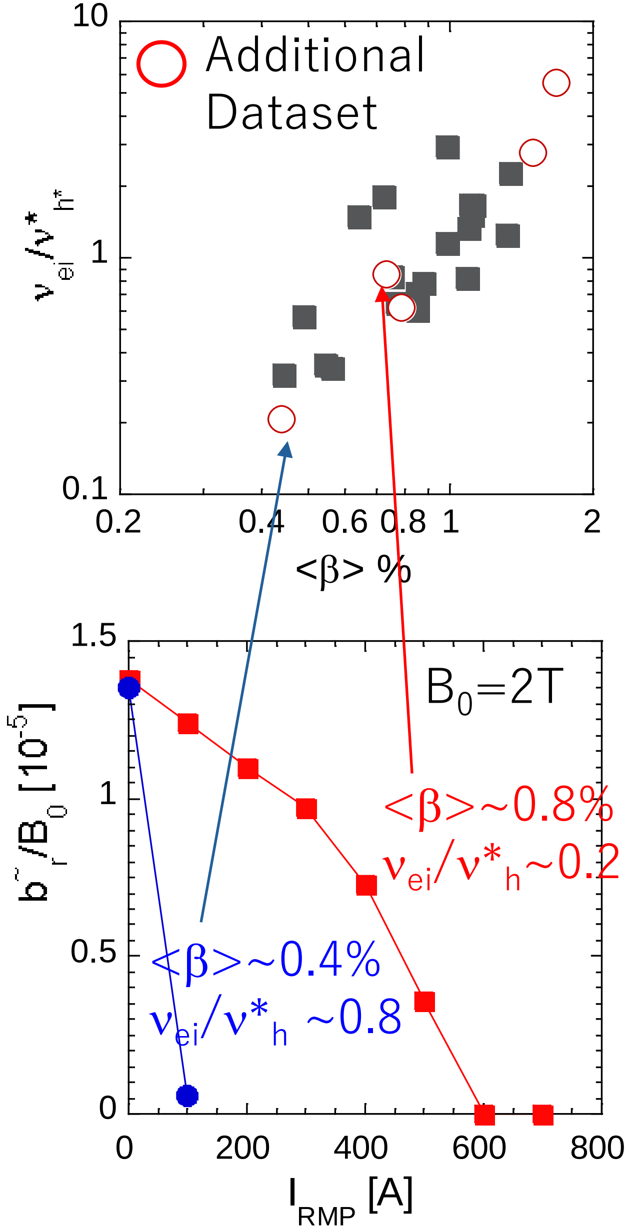
Experimental conditions:

(R_{ax}, Polarity, B_t, γ, B_q) = (3.75m, CW, 2T/1.5T/0.6T, 1.2538, 100%);
#192872-88(2T), 192889-99(1T), 192900-12(0.6T)

Results:

The dataset is extended as shown in the right-top figure. Now we are improving the scaling law of ext. RMP amplitude to suppress the RIC completely. However, the correlation between β and ν*.looks still high.

Next, we will check the correlation under the same normalized ion Lamour radius.



results(tentative)

Plasma shape effect on BSC in high collisional regime (O.Mitarai[, K.Y.Watanabe])

Background and motivation:

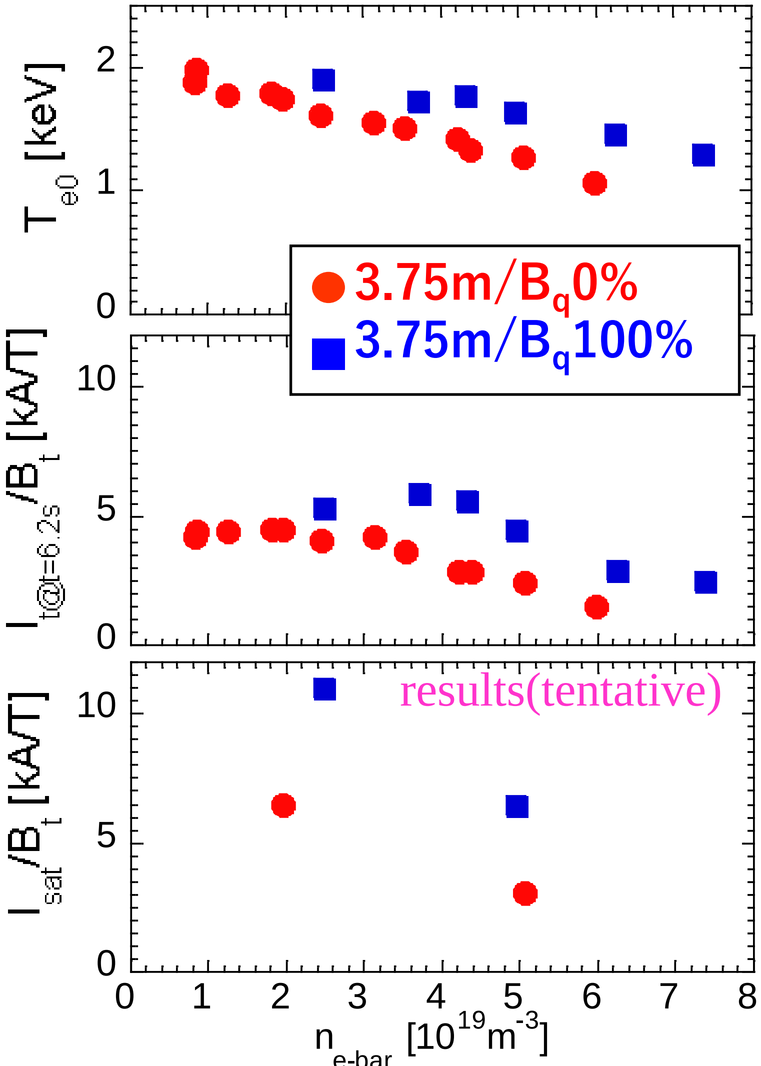
According to a helical fusion reactor design, there is a possibility the BSC(BootStrap Current) affect the MHD equilibrium and instability. We already investigated the BSC dependence on the magnetic axis location and the collisionality, and found that it is reduced in more torus-inward magnetic axis and in more collisional regime. Now, we focus on the magnetic surface shape effect on the BSC. According to a theoretical prediction, elongated deformation of the magnetic surface vertically(B_q0%) reduces the BSC comparing with quasi-circular shape(B_q100%) in a low collisional regime [N. Nakajima et al., NF 29 (1989) 605, and K.C.Shaing et al., POF B1, (8) (1989) 1663]. Now we would like to confirm the plasma shape effect in the relatively high collisional plateau regime in LHD.

Experimental conditions:

(R_{ax}, Polarity, B_t, γ, B_q) = (3.75m, CW, 2.64T, 1.2538, 0%); #192913-917
Balanced NB(BL2+BL3) is injected for 3 second.

Results:

We compare I_p(around the end of discharge) and central elec. temp. dependence in between B_q0% and B_q100% with almost same NBI power. I_p decreases with density in both cases. In the same density, Ip in B_q0% is smaller than that in B_q100%, which is consistent with the theoretical prediction in the low collisionality. However, plasma volume of B_q0% is smaller than that of B_q100%, and the T_{e0} of B_q0% is lower than that in B_q100%. We should take them into account in near future.



T_{e0} and I_p at the end of discharge dependence on density in balance-injected NB discharges.
I_{sat}(I_p in the steady state); ~BSC