(TG2) Turbulence Topical Group Report

Date: Dec. 4, 2022

Dec. 4, 2022 (T. Kobayashi)

Time: 9:45 - 18:45

Shot#: 179538 – 179697 (160 shots)

Prior wall conditioning: NO

Divertor pump: YES

Gas puff: H2, He, Ar , Pellet: NO

NBI#(1, 2, 3, 4, 5)=gas(H, H, H, H, H)=P(3.2, 3.5, -, 4.1, 3.8)MW

ECH(77GHz)=ant(5.5-Uout (or 1.5U), 2-OUR)=P(448, 559)kW

ECH(154GHz)=ant(2-OLL, 2-OUL , 2-OLR)=P(398, 484, 482)kW

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

ICH(3.5U, 3.5L, 4.5U, 4.5L)=P(0.42, 0.33, 0.39, -)MW

Neutron yield integrated over the experiment = 1.4×10^{13}

Topics

1. ECH commissioning (R. Yanai, M. Nishiura)
2. Observation of turbulence transition in hydrogen/deuterium NB plasma (T. Kinoshita, K. Tanaka)
3. Feedback control using turbulence level (H. Sakai, K. Tanaka)
4. Investigation of ETG turbulence threshold in LHD (T. Nasu, T. Tokuzawa)
5. Investigation of shear flows induced by EIC (J. Varela, T. Tokuzawa)

Plasma control using turbulence and exploration of crucial parameter for turbulence transition

H. Sakai (Kyushu Univ.), T. Kinoshita(Kyushu Univ.), K. Tanaka

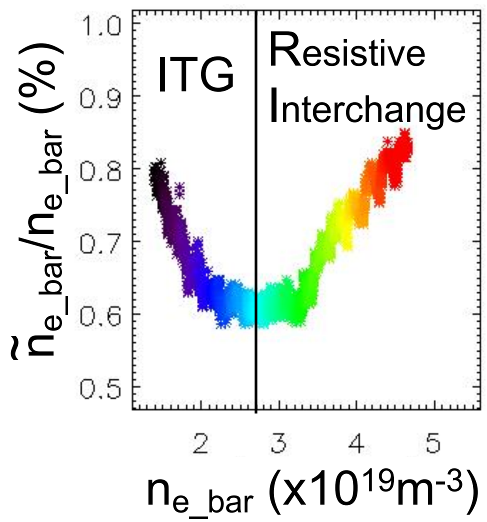
Shot No: #179585~179641 (57shots)
Experimental conditions: (R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CW, 2.75 T, 1.2538, 100 %)
Gas-puff: H

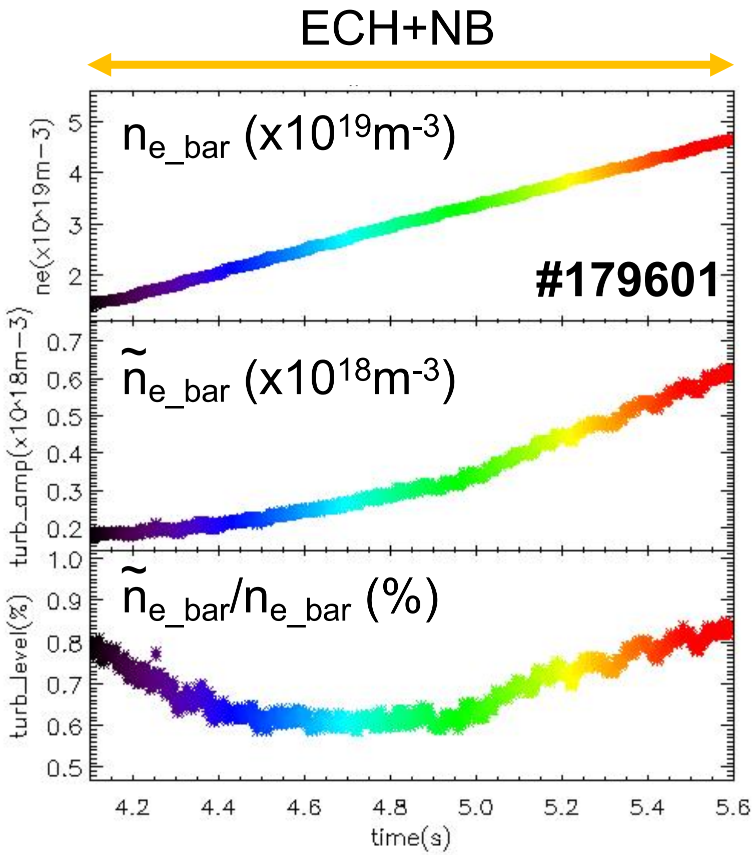
Background
In our previous work, we have found that the dominant turbulence mode changes in the density regime. Furthermore, we found that the turbulence levels is to be minimum at the transition density (T. Kinoshita submitted).

Motivation

・Is it possible to using the turbulence level (TL) signal to realize low turbulence plasma?

・What is a crucial parameter for turbulence transition?



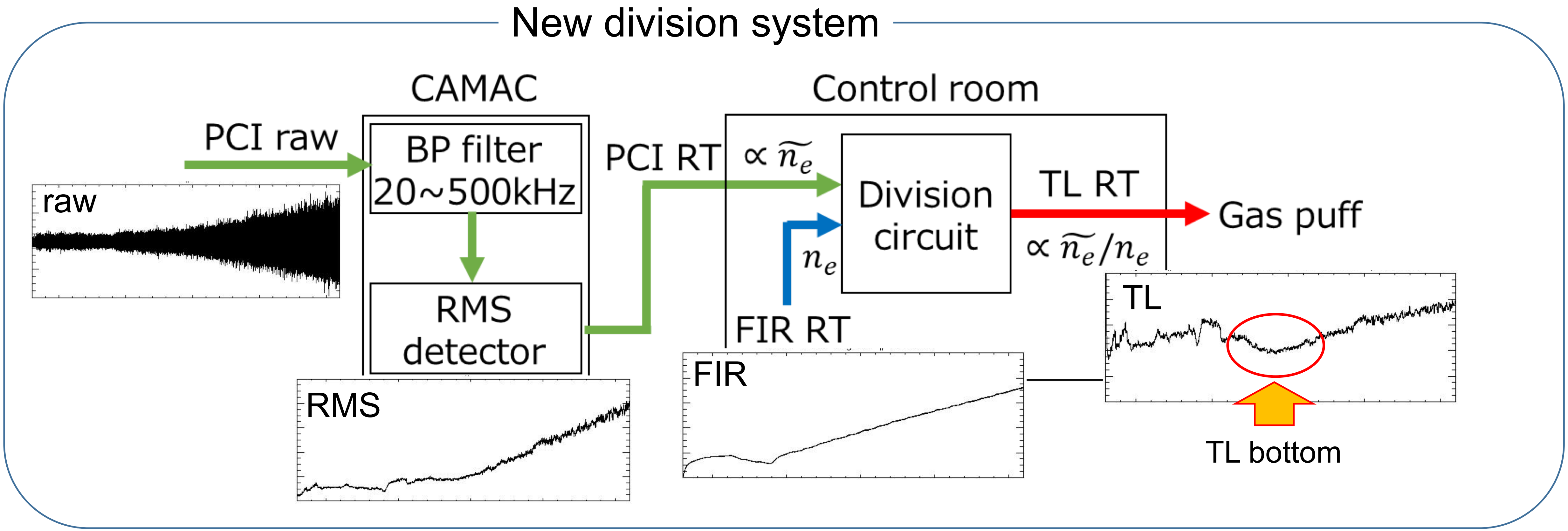


Plasma control using turbulence (H.sakai)

Approach:

In order to obtain the real-time TL signal ($\widetilde{n_e}/n_e$), a new division system was developed.

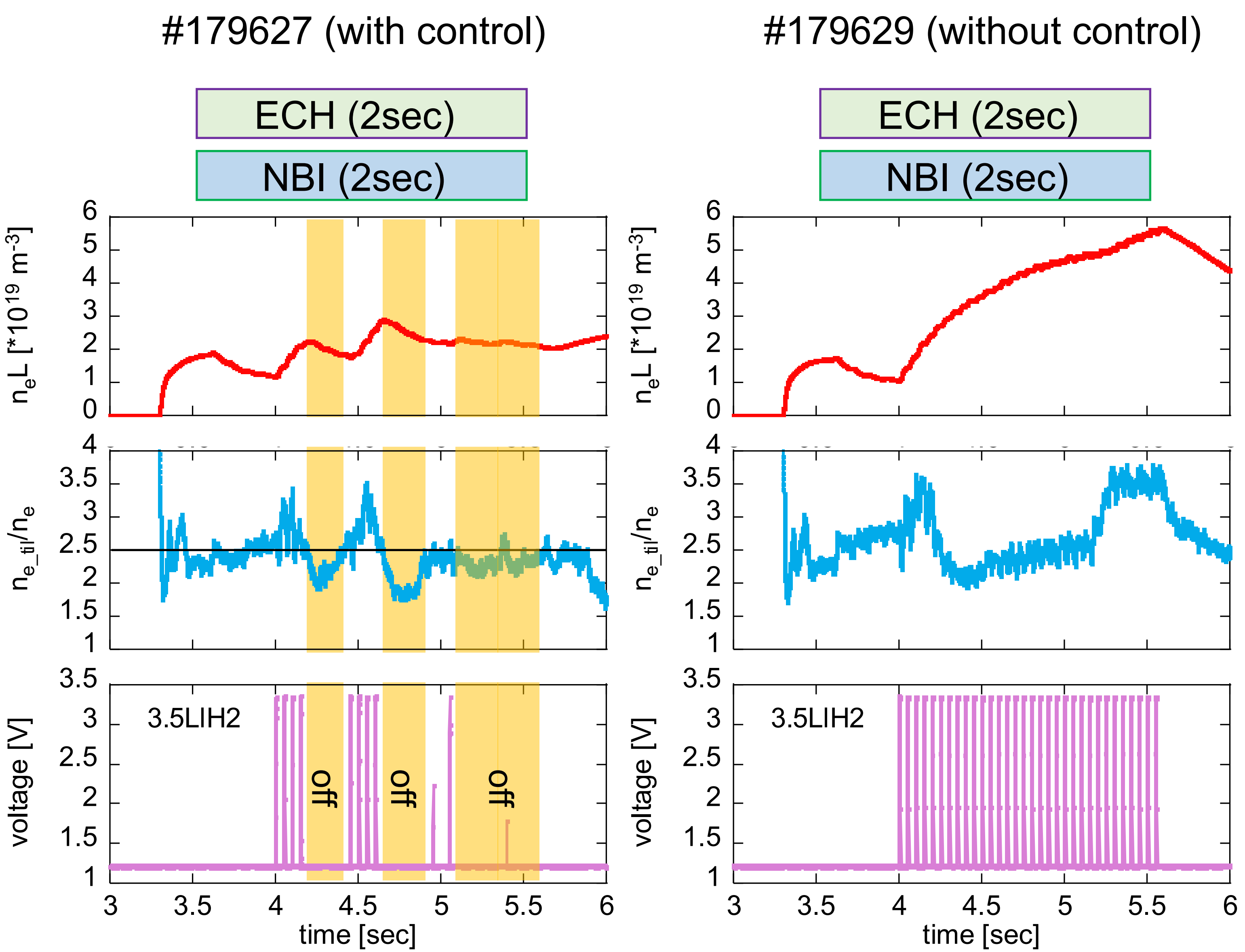
Then, experiments were conducted to maintain low turbulence plasma by using real-time TL signals to control gas puffing.



Plasma control using turbulence (H.sakai)

Result

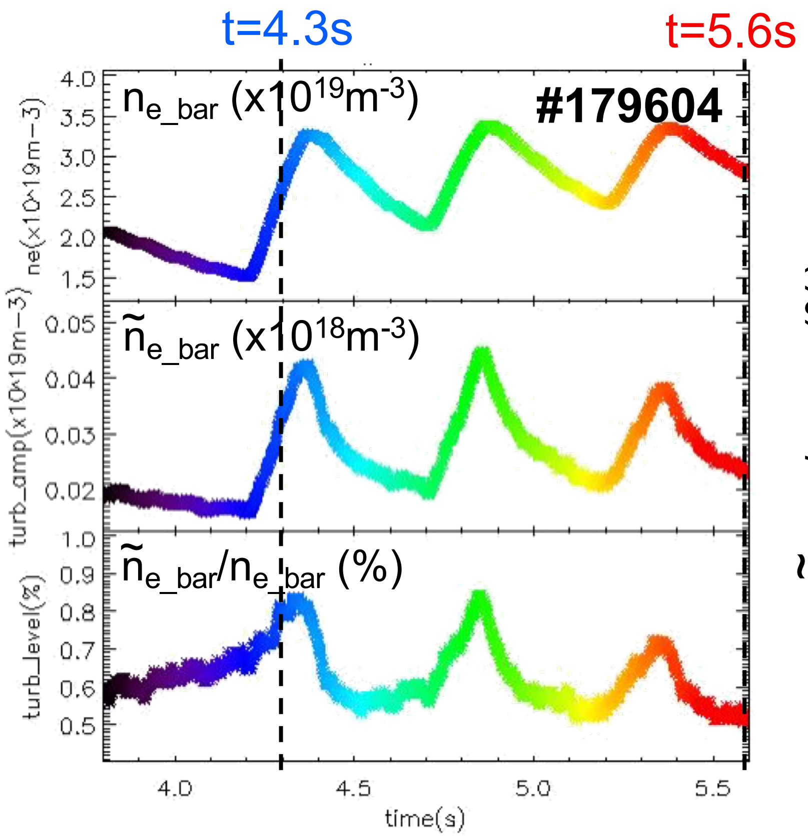
- ✓ 20Hz gas-puffing was conducted.
- ✓ During TL became lower than threshold voltage(2.5V), gas-puffing was controlled to stop.
- ✓ Real time on-off control of gas-puffing by TL signal was successful.

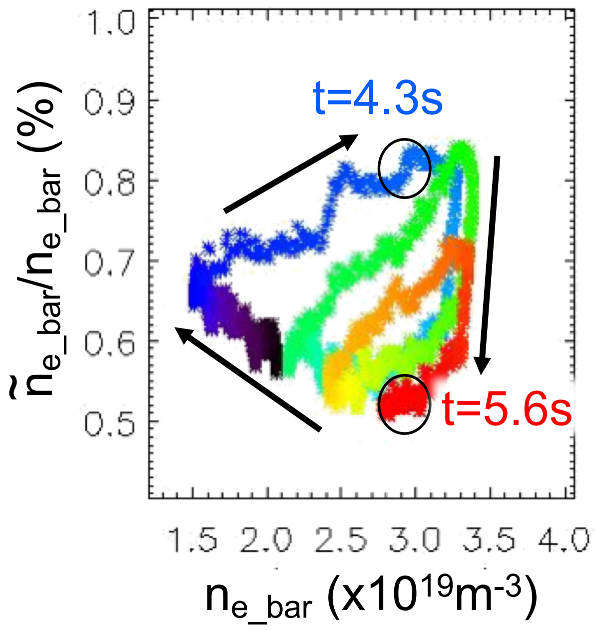


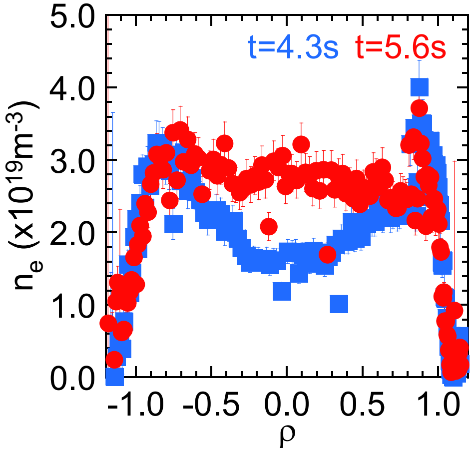
NEXT TARGET 10/28

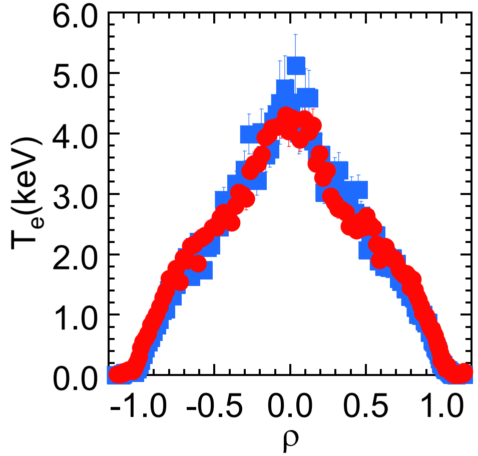
- Continuous gas-puff feedback control
- TL bottom tracking when changing heating

Exploration of crucial parameter for turbulence transition (T. Kinoshita)









Motivation

What is a crucial parameter for turbulence transition?

→ Modulation of electron density across transition density

Results

・ Plasma behaves quite differently when the density is increasing and when it is decreasing.

・ Focusing on t=4.3s and 5.6s, the electron density is almost the same, however, the turbulence level, ne and Te profile are very deferent.

Future plans

・ In order to vary other parameters, additional experiments will be performed under different heating conditions.

・This result may be useful for understanding particle transport evaluated by density modulation experiments.

Investigation of ETG turbulence threshold (T. Nasu, T. Tokuzawa, and M. Nakata)

Shot #: 179642 - 179677

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

(R_{ax}, Polarity, B_t, γ, B_q) = (3.55 m, CW, 2.7887 T, 100 %)

Motivation and objective: To investigate ETG turbulence threshold by measuring electron scale turbulence dependences on R/LTe, Te/Ti, Zeff or R/Lne independently.

Results:

- ➢ Controlling heating power balance of inner-off-axis ECH (ρ~0.2) and outer-off-axis ECH (ρ~0.6), we observed electron-scale turbulences by BS measurement at ρ~0.4.
- ➢ H_e gas puffing was used to increase Zeff.
- ➢ ∇n_e was changed between two magnetic configurations.

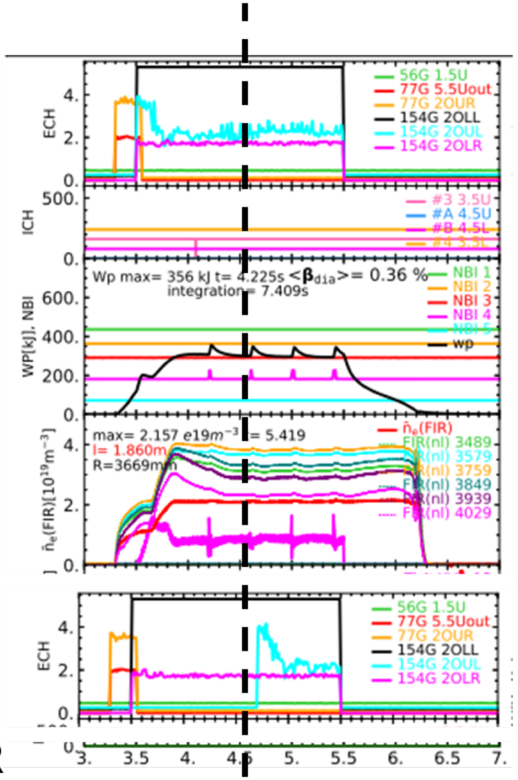
- ➢ We achieved observing electron-scale turbulence on negative and positive ∇T_e at the similar T_e, T_i, n_e, ∇T_i, and ∇n_e.
- ➢ We will check whether the other dependences was attained in the near future.

@ 4.6 s

#179653

All 154G

r_{eff}/a_{99} ~ 0.6



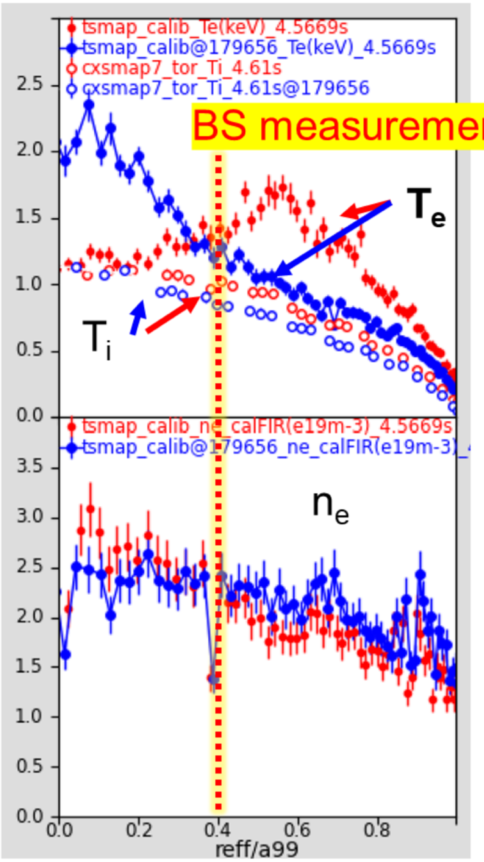
#179656

154G 2OLL

r_{eff}/a_{99} ~ 0.2

154G 2OLR

r_{eff}/a_{99} ~ 0.6



#179653

#179656

Investigation of shear flows induced by EIC

(J. Varela, C. Hidalgo, T. Tokuzawa, S. Ohdachi, K. Nagasaki, K. Nagaoka)

Shot #: 179678 - 179697

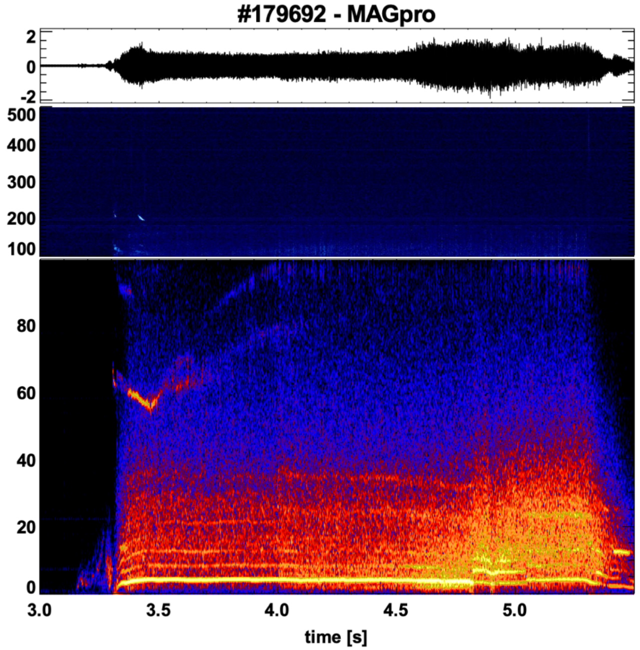
Experimental conditions: (R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CW, 2.75 and 1.375 T, 1.254, 100 %)

Motivation and objective: To investigate the generation of shear flows by EIC

Results:

- Scan of the EIC stability with respect to the thermal plasma density using balanced NBI (NBI1 + NBI2) and perpendicular NBI 4 and 5.
- The shear flows and plasma potential measured using CXS and HIBP.
- Scan of the EIC stability modifying the heating pattern:
  - Half tangential NBI power.
  - ECH injection at r/a = 0.8 and 0.6.
- Analysis of EIC stability in the reference shot with half magnetic field.
- Half field + ECH + ICH shot.

179692 B = 2.75 T
NBI4+NBI5+ECH



179694 B = 1.375 T
NBI4+NBI5