(TG4) Plasma instability group report

Date: Dec. 1, 2022

Dec.2, 2022 (K. Nagaoka)

Time: 9:30 - 18:45

Shot#: 184865-185000 (136 shots)

Prior wall conditioning: None

Divertor pump: On

Gas puff: H2, He, Ar, Pellet: H2

NBI#(1, 2, 3, 4, 5)=gas(H, H, H, D, D)=P(4.0, 3.8, 4.0, 5.5, 8.7)MW

ECH(56GHz)=ant(1.5-U)=P(0)MW

ECH(77GHz)=ant(5.5-U, 2-OUR)=P(0.7, 0.8)MW

ECH(154GHz)=ant(2-OLL, 2-OUL, 2O-LR)=P(0.7, 0.8, 0.8)MW

ICH(3.5U, 3.5L, 4.5U, 4.5L) = P(0, 0, 0, 0)MW

Neutron yield integrated over experiment = (3.4E+14)

Topics

1. Production of anisotropic high energy electrons using flux swing in low magnetic field and excitation of RF waves in Whistler frequency range (S. Kobayashi / K. Nagaoka / H. Igami)
2. AE excitation with fundamental resonance at low-field plasma experiments (K. Nagaoka)
3. Driving mechanism of edge instability with collapse (Y. Takemura)
4. CDC dynamics and rotational transform/CDC dynamics and rotational transform (H. Thomsen / S. Ohdachi)

Production of anisotropic high energy electrons using flux swing in low magnetic field and excitation of RF waves in Whistler frequency range

Kobayashi (Kyoto Univ.), Nagaoka, Igami

Experimental conditions:

Shot numbers: #184867 - #184908

(R_{ax}(B_t), Polarity, γ, B_q) = (3.55-3.9m@B=0.4T & 3.6-3.75m@B=0.75T w/ flux swing, CCW, 1.2538, 100%)

NBI: #1 (2MW), #2 (4MW) , #3 (4MW)

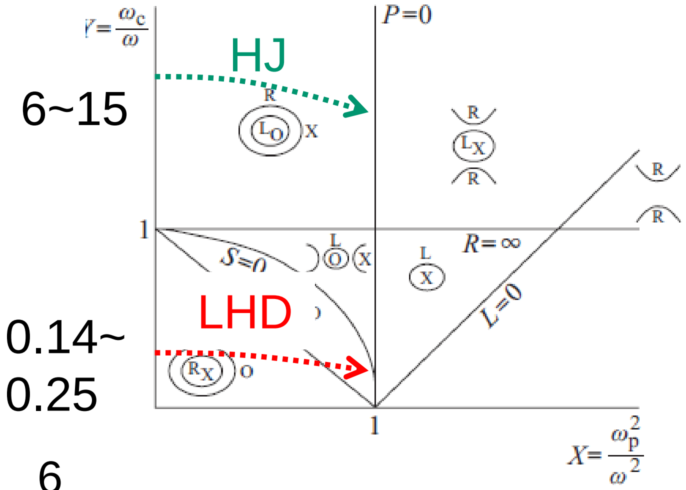
ECH: 77GHz 5.5U (100kW, O & X-mode), ICH:

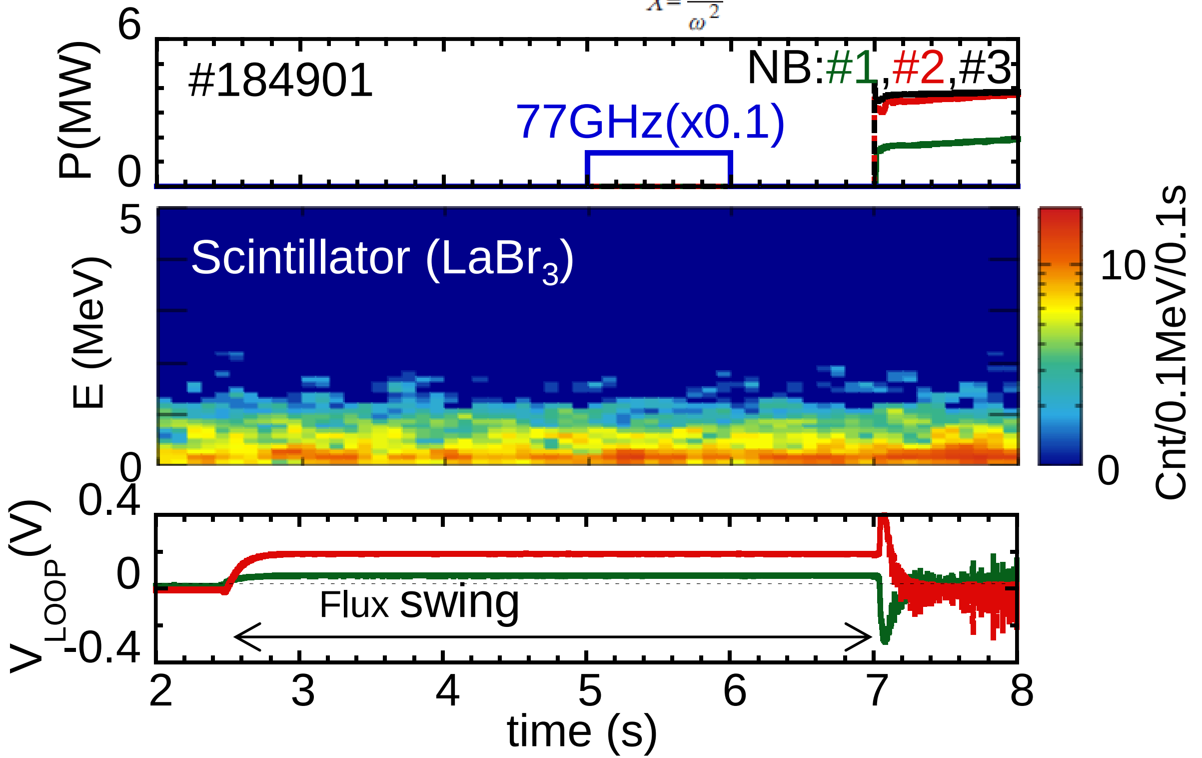
Background and motivation:

- Feasibility study for stochastic accel. in LHD, which has been observed in HJ and WEGA using non-resonant wave heating (ω_{ce}/ω=6~15).
- Production of initial electrons with sufficient energy required for stochastic accel.

Results:

- High energy X-ray flux has not been observed when 77GHz turned on even V_{LOOP} ~ ±0.2V using flux swing.
- NBI start-up has been succeeded at B=0.4T. w/ & w/o ICH assist.





AE excitation with fundamental resonance at low-field plasma experiments

K. Nagaoka

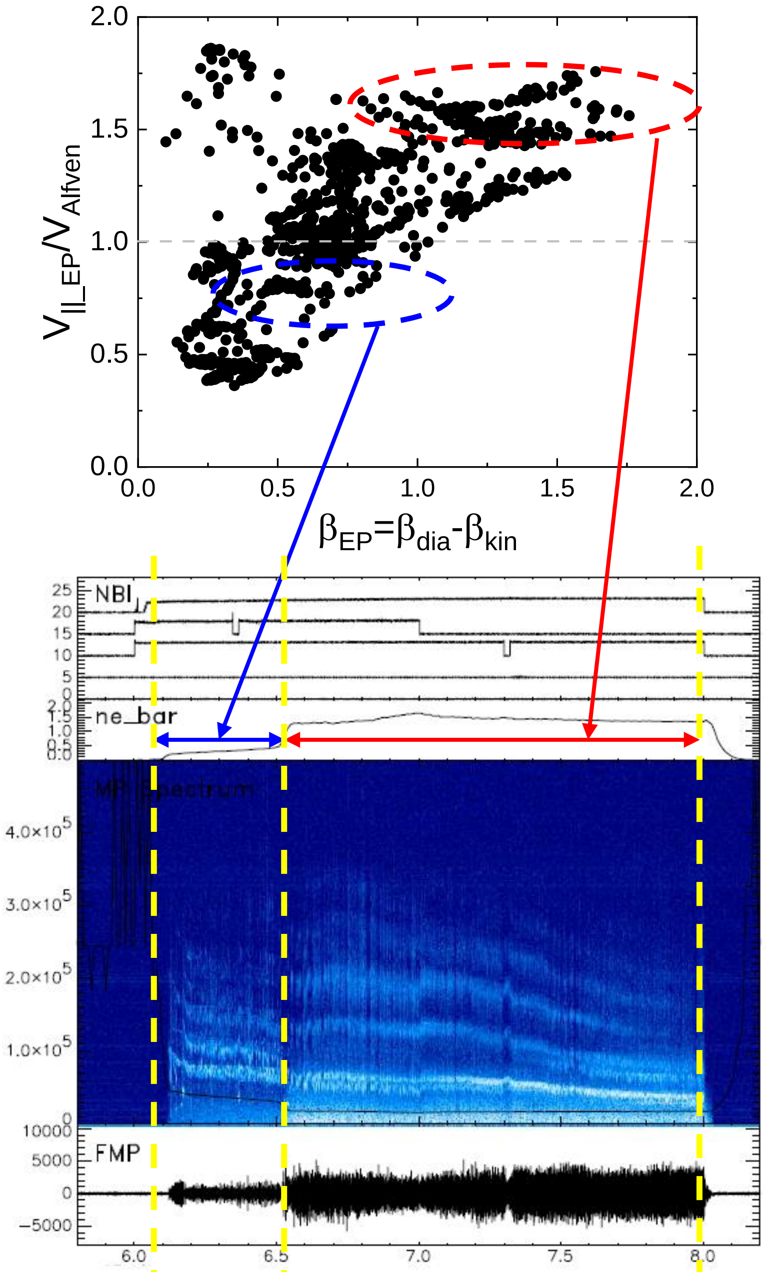
Experimental conditions:
Shot numbers: #184867 - #184908
(R_{ax}, Polarity, B_t, γ, B_q) = (3.55-3.9m & 3.6-3.75m w/ flux swing, CCW, B=0.4T & 0.75T, 1.2538, 100 %,)
NBI: #1 (2MW), #2 (2MW) , #3 (2MW)
ECH: 77GHz 5.5U (100kW, w/o resonance), ICH:

Background and motivation:

- Alpha particles produced by D-T reaction in torus plasmas are predicted to be faster than Alfven velocity. Fundamental resonance ($V_{EP}=V_A$) would dominate the interactions in the burning plasmas.
- Target of this experiment is AEs excitation with the fundamental resonance condition

Results:

- The fundamental resonance condition was realized with very low-field experiment.
- Stronger AEs were observed in the super Alfvenic condition, and the comparison with 1/3 V_A resonance will be analyzed.



184876

Driving mechanism of edge instability with collapse

Y. Takemura

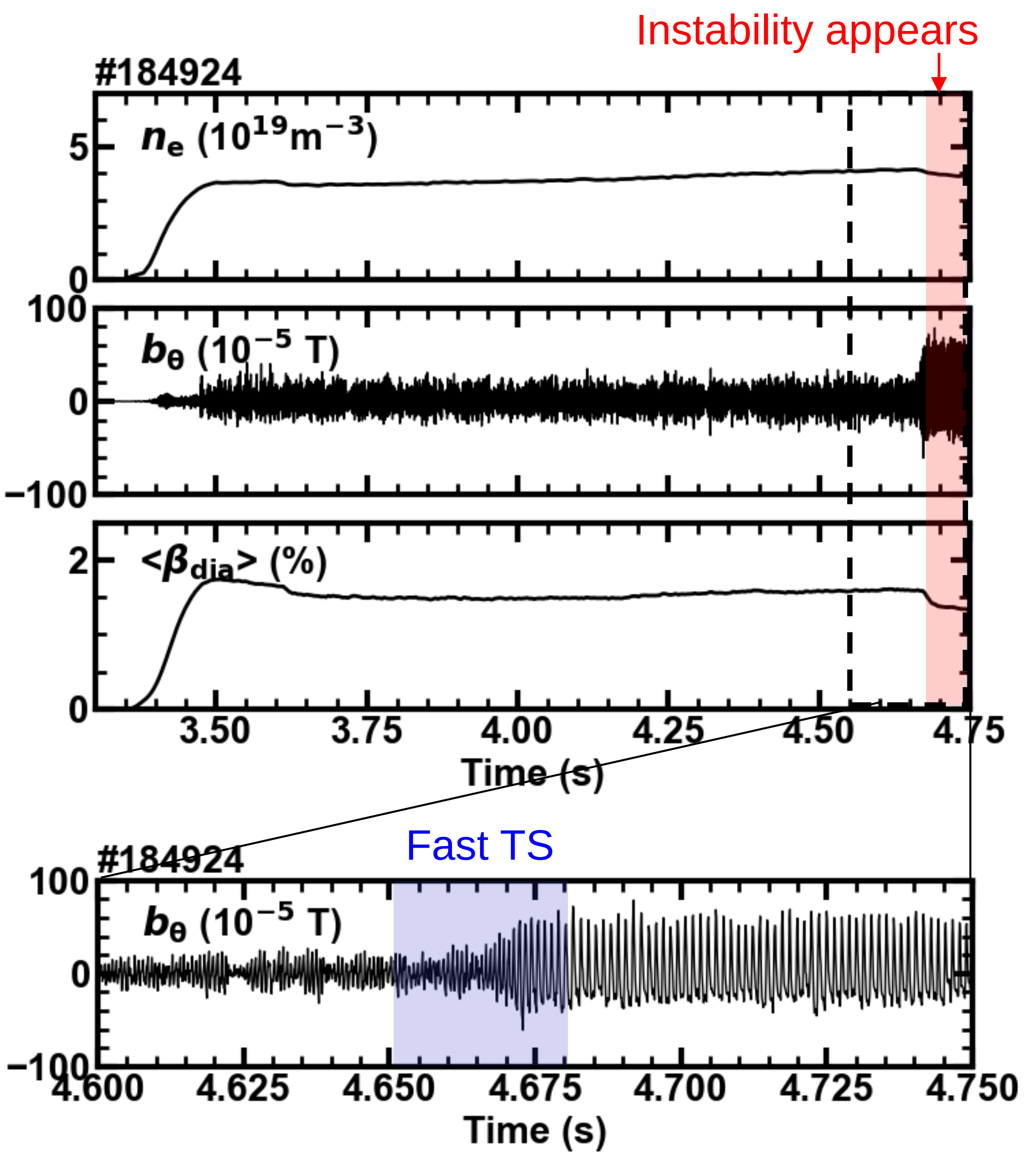
Experimental conditions:
Shot numbers: #184909 - #184955
(R_{ax}, Polarity, B_t, γ, B_q) = (3.75 m, CCW, 0.75 T, 1.2538, 100 %)

Background and motivation:

- In a relatively high-density region, the instability with island with minor collapse is observed. Before the collapse, island width measured by the interferometer increases and saturates.
- The aim is observation of the structure of an initial island related with the driving mechanism of the instability.
  →require diagnostics with high spatial resolution.
- In addition, RMP effect on mode structure of the instabilities is investigated in order to understand usefulness of external RMP coils for the mode stabilizing.

Results:

- Mode structure of local electron temperature fluctuations in island growing phase by using fast TS measurement is obtained.
- Mode structure with different external RMP amplitude is also measured.



CDC dynamics and rotational transform

S. Ohdachi, H. Thomsen (IPP. Germany), Y. Suzuki (Univ. Hiroshima), M. Yoshinuma

Shot #: 184957-184999

Experimental conditions:

(R_{ax}, Polarity, B_t, γ, B_q) = (3.90, CCW, -2.538T, 1.254, 100), (3.75, CCW, -2.64T, 1.254, 100))

Background and motivation:

- Similar crashes in Wendelstein 7-X high performance discharges might have the same origin
- In a previous study, CDC crashes could be analyzed with the MSE system only for R_{ax} = 3.85
- The details of the CDC mechanism should be checked for the influence of iota (R_{ax})

Results:

- Reproduction of CDC and MSE calibration in R_{ax} = 3.90m were successful.
- In the second configuration (R_{ax} = 3.75m), establishment of CDC was not successful
- Based on the quality of the MSE-data, a more detailed comparison can be started.

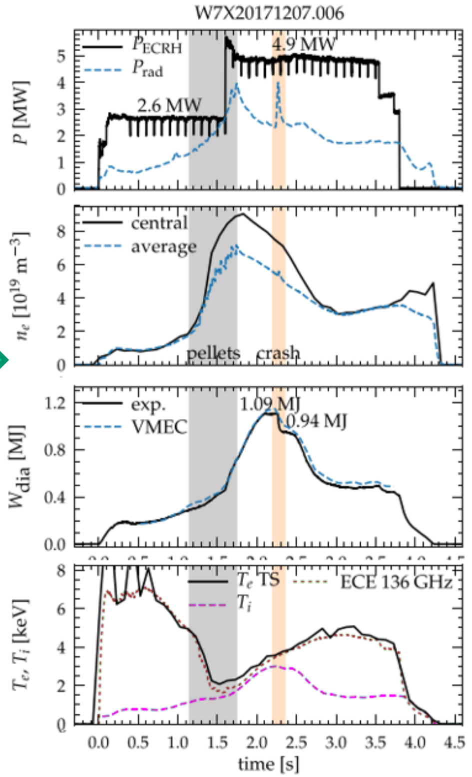


Fig. 1. W7-X MHD event [S. Bozhenkov et al, NF 2020]

- Since the variation of CDC timing is not large, profile evolution at the collapse events with fast-Thomson measurement might be obtained.

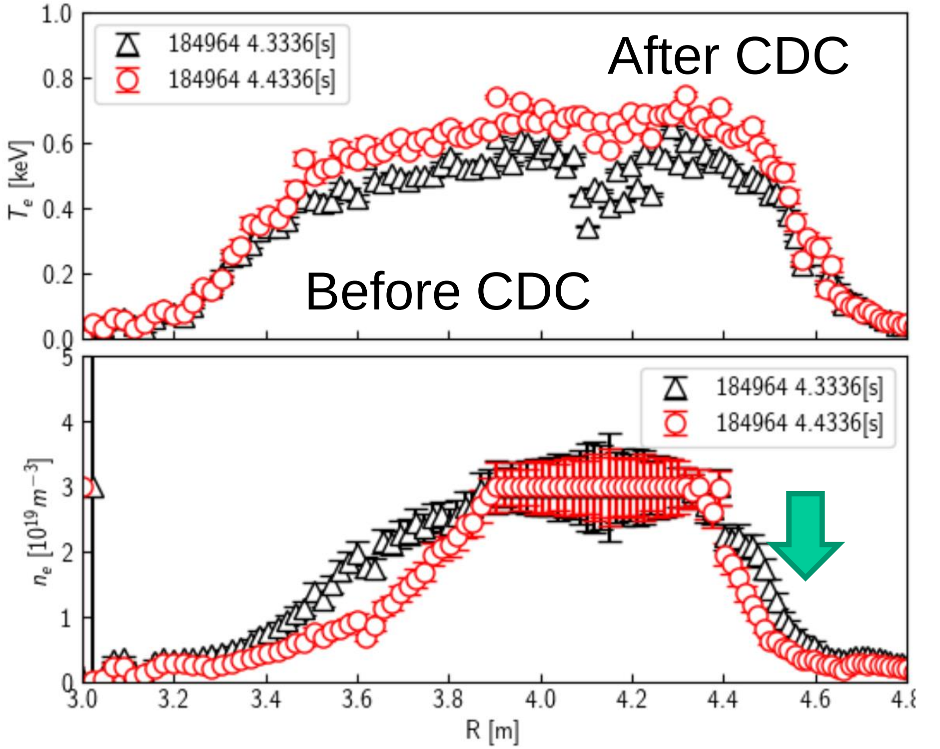


Fig. 2. Change Te and ne profile with CDC

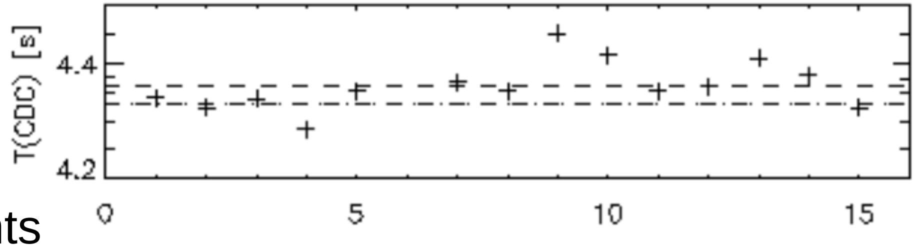


Fig. 3. Timing of the CDC collapse event. 4.33s-4.36s are measured with 1kHz mode