(TG4) Plasma instability group report

Nov. 16, 2021 (S. Kamio)

Date: Nov. 12, 2021
Time: 9:50 - 18:45
Shot#: 172473 – 172622 (150 shots)

Prior wall conditioning: No
Divertor pump: On except for 2-I
Gas puff: D2, Pellet: No
NBI#(1, 2, 3, 4, 5)=gas(H, D, D, D, D)=P(5.5, 2.9, 2.1, 4.4, 5.2)MW
ECH(77GHz)=ant(5.5-Uout (or 1.5U), 2-OUR)=P(700, 790)kW
ECH(154GHz)=ant(2-OLL, 2-OUL , 2-OLR)=P(980, 730, 990)kW
ECH(56GHz)=ant(1.5U)=P(0)kW
ICH(3.5U, 3.5L, 4.5U, 4.5L)=P(0.58, 0.58, 0.87, 0.50)MW
Neutron yield integrated over experiment = 2.4×10^{16}

Topics

1. Observation of knock-on tail (H. Matsuura)
2. Hydrogen and deuterium beam ion transport due to toroidal Alfvén eigenmode (S. Kamio)
3. Estimation of the Coulomb collision between fast-ions (non-linear collision) (H. Nuga)

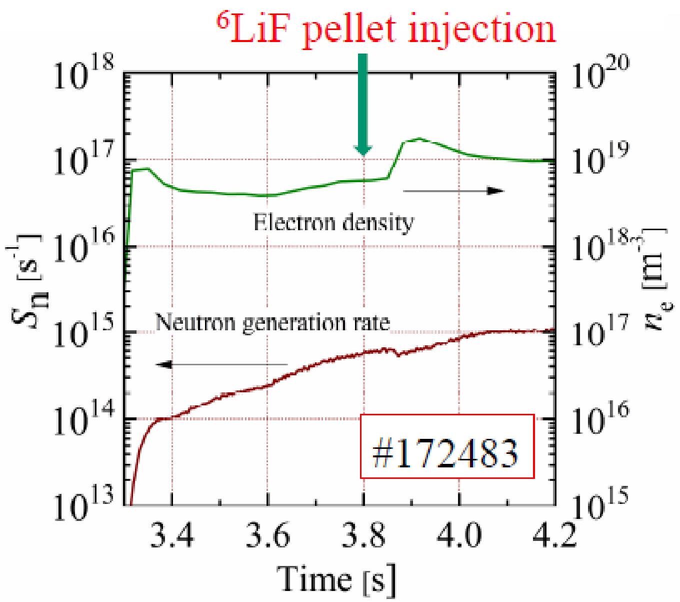
Observation of knock-on tail

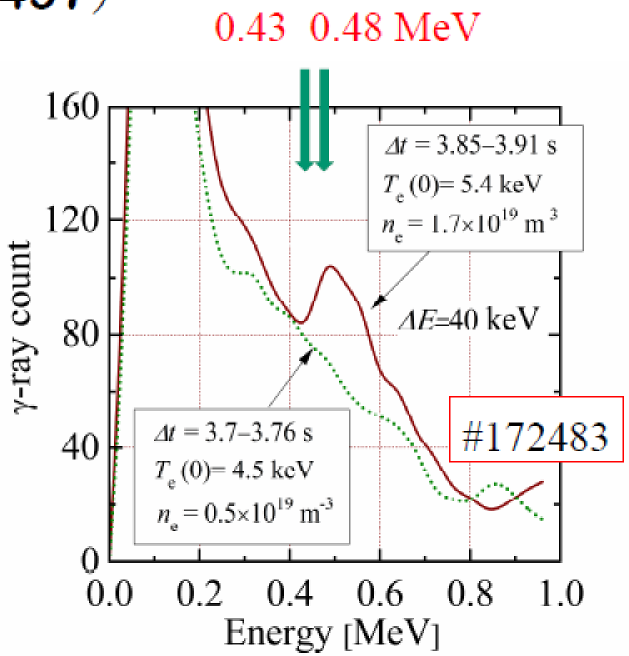
H. Matsuura, K. Ogawa et al.

Experimental conditions: R_{ax}= 3.6 m, CCW, B_t = 2.75 T（#172475 - #172497）

1. γ-ray (by ^{6}Li-d reaction) measurement in D-beam (NBI#2,3,4,5) injected plasma

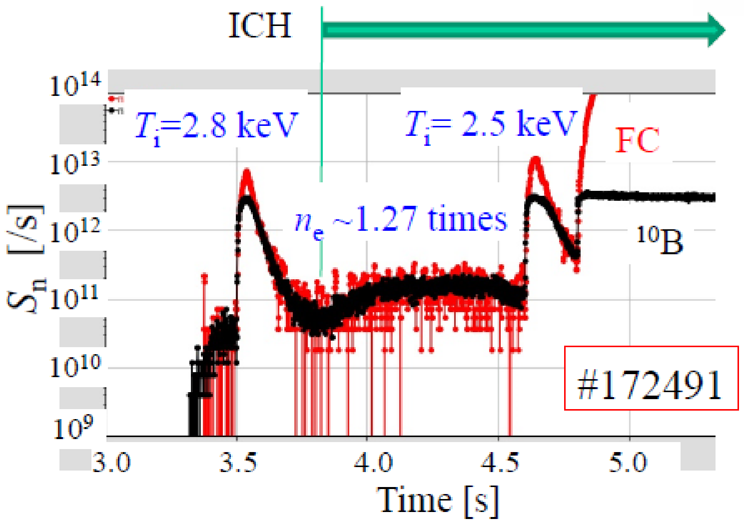
- ^{6}LiF pellet was injected into deuterium plasma with D (#NBI 2,3,4,5) and H (#1) beam heating.
- γ-rays which may be emitted from ^{6}Li(d,nγ)^{7}Be/ ^{6}Li(d,pγ)^{7}Li reactions were measured first time.





2. Knock-on tail observation in ICH plasmas

- The neutron generation rate increased after ICRF waves were injected.
- Experiment was performed in high-electron-temperature plasmas, i.e., $T_e(0)$ =6~10 keV.
- Ion temperature (measured by CXS) could be kept beyond 2 keV.
- Some kind of influence of fast deuterons could be suggested.



	Before ICH	After ICH
Time [s]	3.45~3.5	4.2~4.5
S_n [s^{-1}]	3× 10^{10}	1.5× 10^{11}
n_e [m^{-3}]	3.6× 10^{18}	5× 10^{18}
T_i [keV]	2.8	2.5
T_e [keV]	6.3	4.6

Hydrogen and deuterium beam ion transport due to toroidal Alfvén eigenmode

S. Kamio, K. Ogawa, et al.

Experimental conditions:
(R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CCW, 0.50 T, 1.254, 100%),
(3.6 m, CCW, 0.60 T, 1.254, 100%)

Background and motive

- Clarifying the behavior of TAE in the presence of multiple energetic particle species by simultaneous injection of H and D beams using NB#1 and #3.
- To investigate the possibility of using ICRF to start-up plasmas in experiments at 0.5 T, where ECH is not available, ICRF is injected into the vacuum.

Results

- Successful plasma start-up using ICRF.
- We successfully accumulated the experimental data on mixed beams including density scans in multiple magnetic field configurations.
- Unfortunately, E||B-NPA could not be an active measurement by using NB#3 modulation injection.

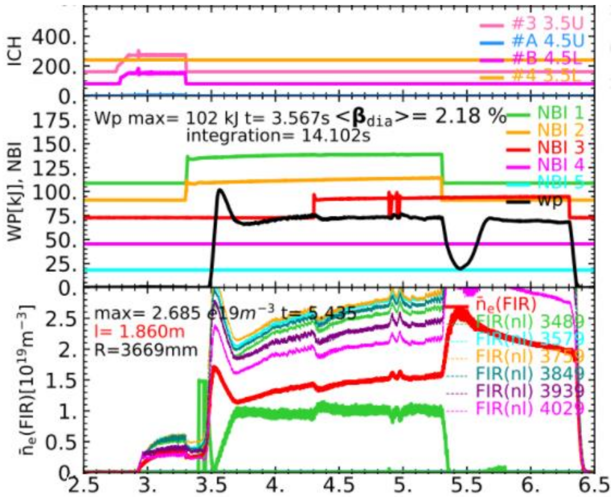


Fig1. Start-up by ICRF

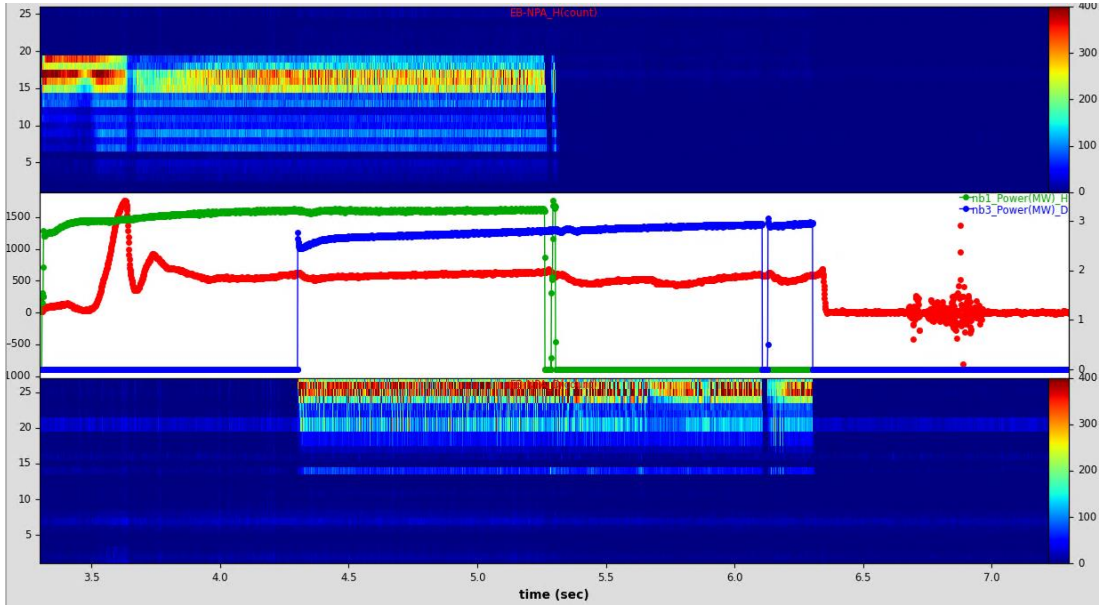


Fig2. Signals of E||B-NPA during the TAE burst experiment

Estimation of the Coulomb collision between fast-ions (non-linear collision)

Shot #: 172581-172622 (42 discharges) H. Nuga

Experimental conditions:

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

Background and motivation:

- Coulomb collision between fast-ions (Non-Linear Coulomb collision) can be measured through the decay time of the neutron emission rate.
- NL collision will occur between 1 MeV D beam and 3.5 MeV alpha particle in ITER and may affect instabilities.
- Aim of this exp. is the experimental demonstration of NL collision between fast-ions .

Summary:

- Unfortunately, the success rate of NB injection is poor due to the difficulty of short pulse injection. (7/42)
- Weak extension of the neutron decay time is observed in the low-density plasma.
  - NB#1 fast-ions collide with NB#3 fast-ions.
  - Power of NB#1 is low as compared to that of19th cycle.
  - NL coll. effect is weak.
- Systematic analysis of this series of experiments is required for detailed discussion.