(TG2) Turbulence Topical Group Report

Date: Jan. 13, 2022 Jan. 14, 2022 (T. Tokuzawa)
Time: 9:45 - 18:45
Shot#: 176195 – 176342 (148 shots)

Prior wall conditioning: NO
Divertor pump: ON
Gas puff: H2, Ar , Pellet: H2
NBI#(1, 2, 3, 4, 5)=gas(H, H, H, H, H)=P(4.4, 3.2, 3.8, 3.6, 3.7)MW

ECH(77GHz)=ant(5.5-Uout (or 1.5U), 2-OUR)=P(703, 792)kW
ECH(154GHz)=ant(2-OLL, 2-OUL , 2-OLR)=P(979, 930, 986)kW
ECH(56GHz)=ant(1.5U)=P(327)kW
ICH(3.5U, 3.5L, 4.5U, 4.5L)=P(-, -, -, -)MW
Neutron yield integrated over the experiment = 9.3×10^{12}

Remarks

The start time of data acquisition was delayed due to weather conditions (snow).

Topics

1. Measurements of H-mode plasma (W. Hu)
2. Nonlinear spatiotemporal dynamics of edge fluctuations (C. Moon)
3. Study of turbulence pulse properties during the minor collapse events of e-ITB (N.Kenmochi)
4. Isotope effects on plasma confinement properties and nonlinear interaction of multi-scale turbulence (J.Cheng)
5. 5D-velocity space tomography for fast ions (M. Nishiura)

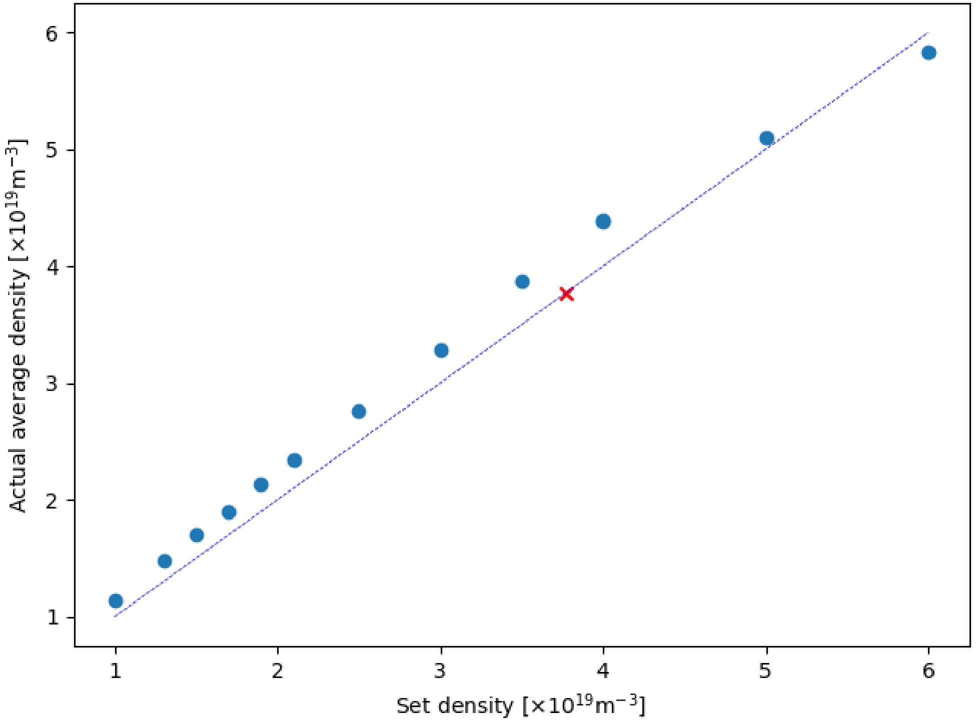
Measurements of H-mode plasma (W. Hu and T. Kobayashi)

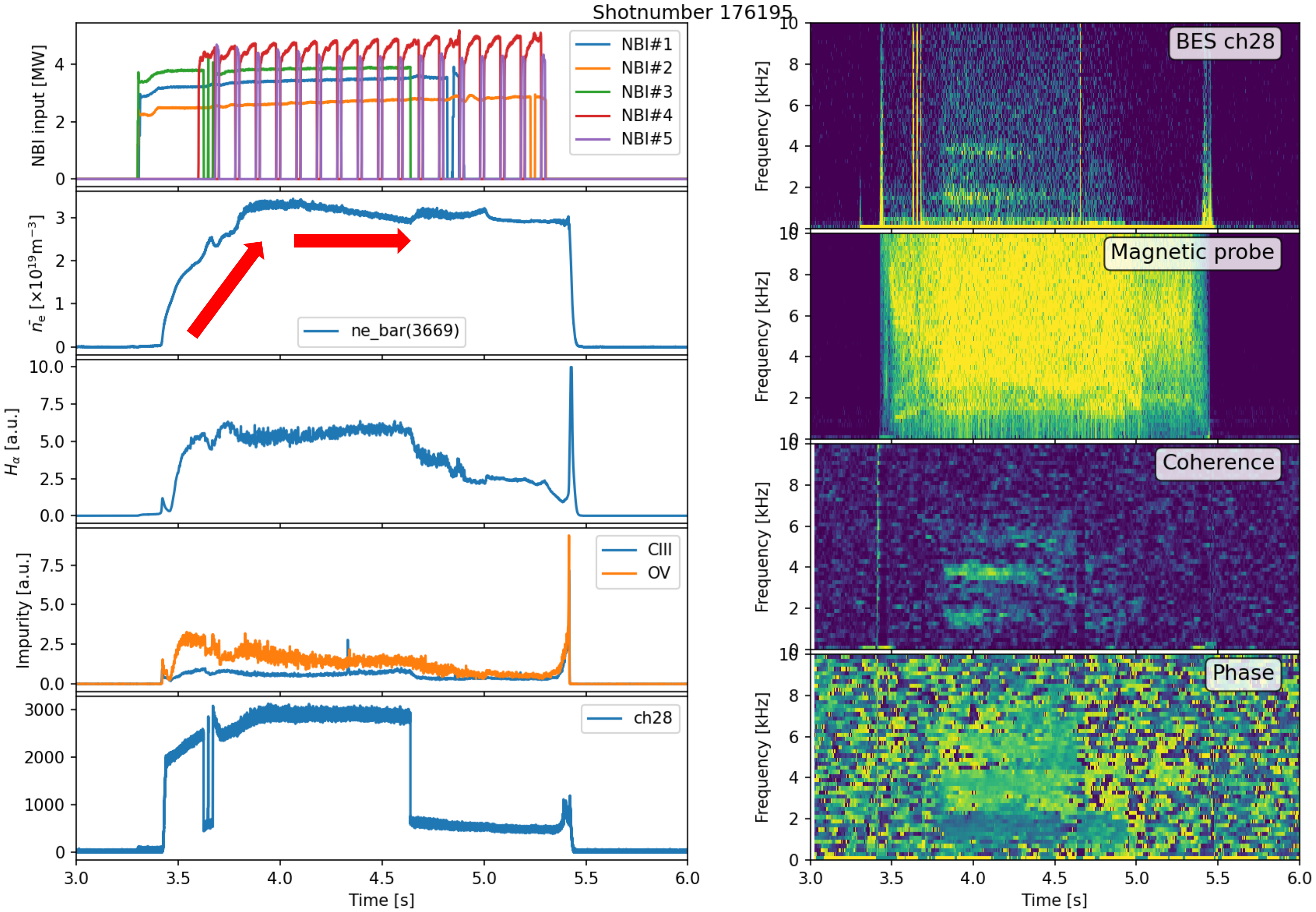
Experimental conditions: (R_{ax}, B_t) = (3.6 m, -1 T), γ = 1.2538, and B_q = 100 %, #176195-176236

Motivation and objective: To investigate characteristics of MHD fluctuations in LHD H-mode plasma.

Results:

- We successfully reproduced the reference shot (#156774).
- Mode transition occurred in the density ramp-up phase, with MHD modes of our interest.
- Shots with different density setting were obtained.





Nonlinear spatiotemporal dynamics of edge fluctuations (C. Moon)

Shot #: 176238 - 176273

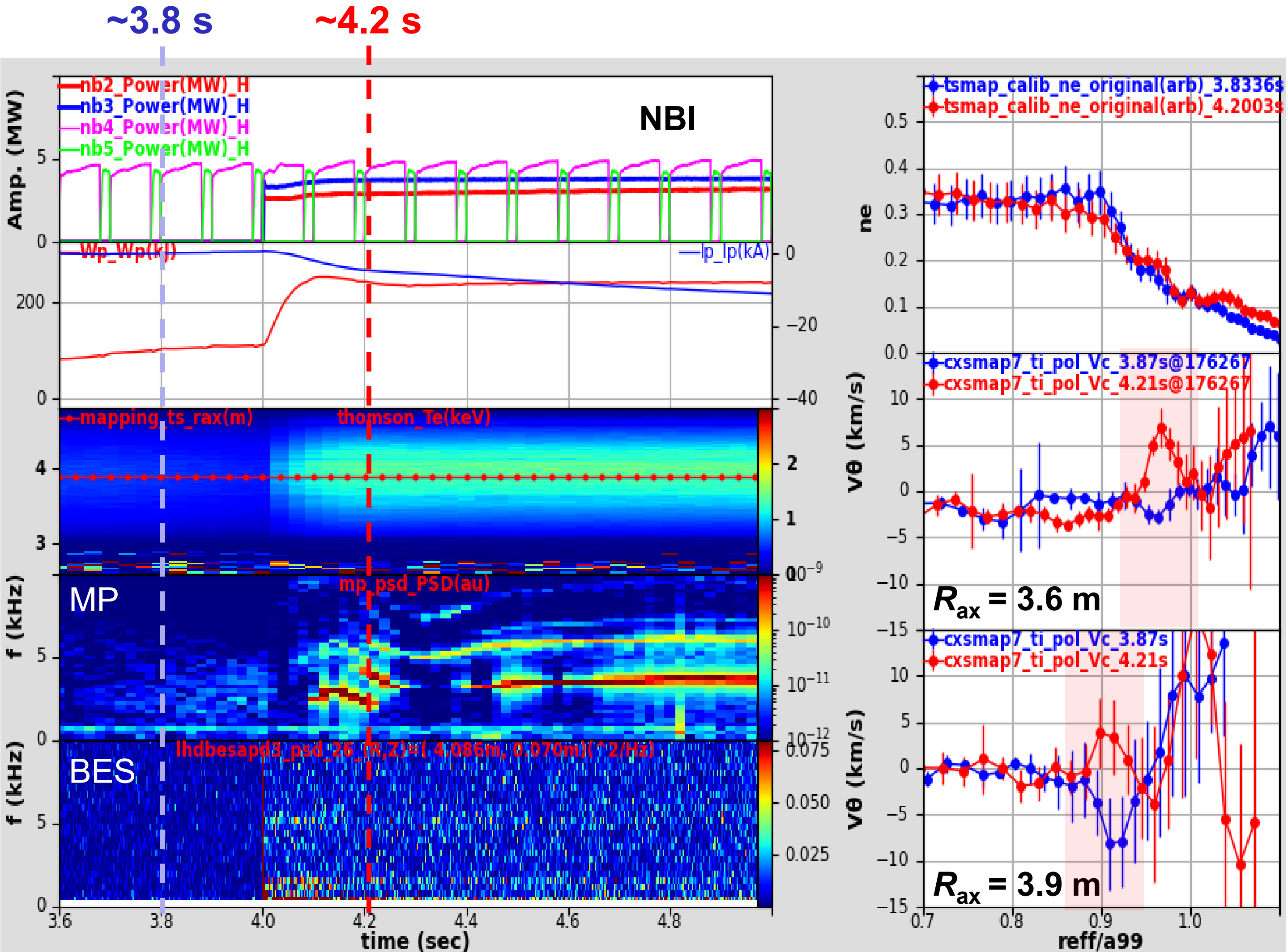
Experimental conditions: (R_{ax}, Polarity, B_t, γ, B_q) = (3.9 m, CCW, 2.53 T, 1.2538, 100 %)
(R_{ax}, Polarity, B_t, γ, B_q) = (3.75 m, CCW, 2.64 T, 1.2538, 100 %)
(R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CCW, 2.75 T, 1.2538, 100 %)

Motivation and objective

- Investigation of the nonlinear spatiotemporal dynamics of low-frequency fluctuations, which are excited in a transition of the poloidal flow velocity (V_θ).

Results

- The vacuum magnetic axis scan was performed with R_{ax} = 3.9 m, 3.75 m, 3.6 m.
- The transition of poloidal flow velocity (V_θ) are successfully observed in edge plasmas.
- The position of the V_θ transition is changed.
- The low-frequency fluctuations are successfully observed (BES, MP).



Study of turbulence pulse properties during the minor collapse events of e-ITB

(N. Kenmochi)

Experimental conditions:

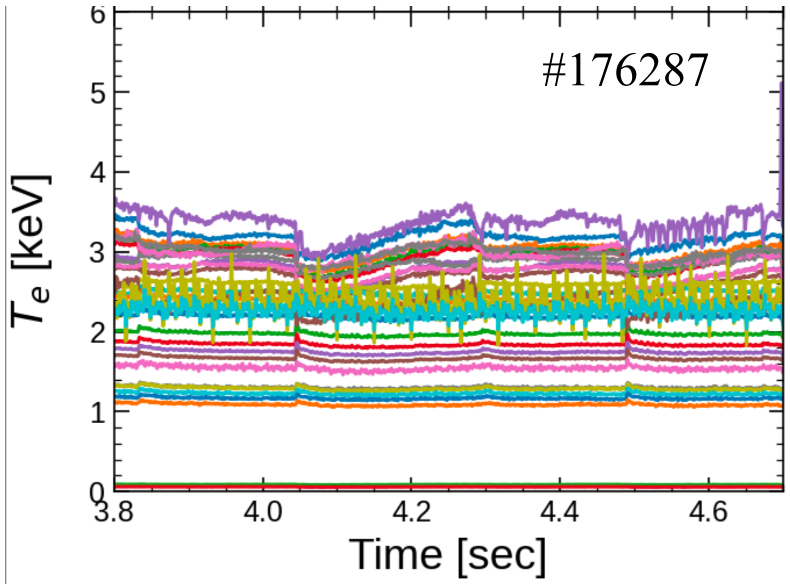
(R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CCW, 2.75 T, 1.2538, 100.0%)

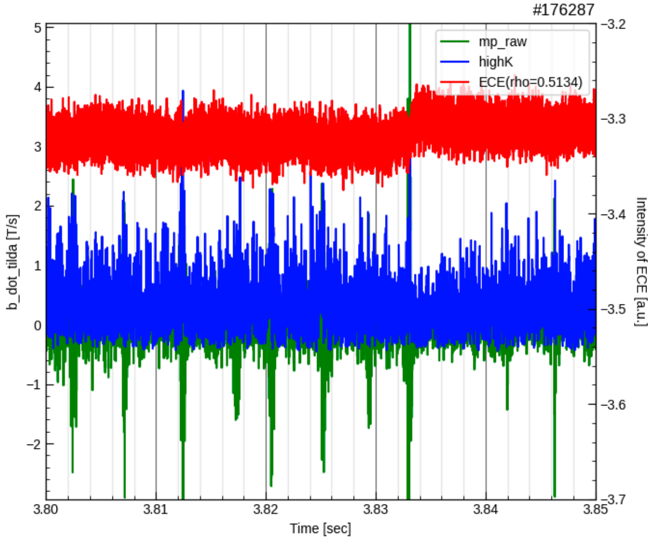
Co. to Ctr. current drive at center region (#176274 - #176295), Hydrogen plasma

Objective: To investigate turbulence pulse properties during the minor collapse events of e-ITB.

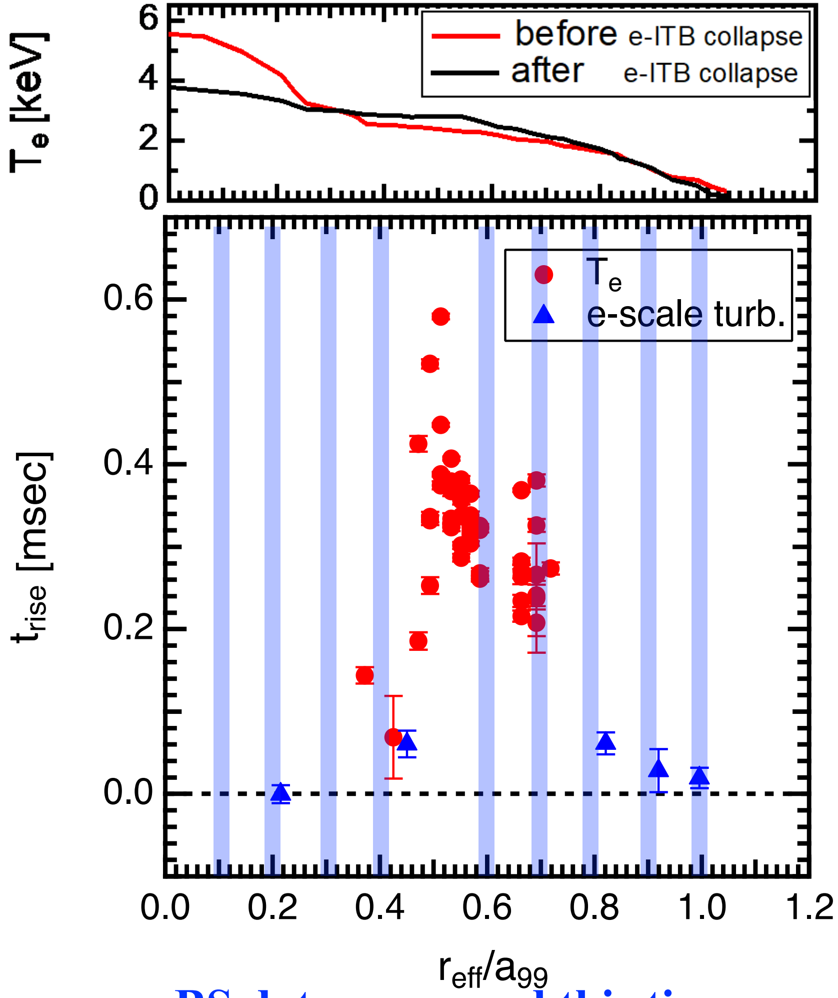
Results:

- ✓ H/(H+D) = 0.25
- ✓ Minor collapse of eITB was observed around n/m=1/2 magnetic island.
- ✓ The electron-scale turbulence and magnetic fluctuation rapidly increase just before the minor collapse.
- ✓ The measurement position of e-scale turbulence was scanned in a shot-to-shot basis.
- ✓ The turbulence pulse properties considering the relationship between T_e profile, heat pulse will be investigated.





Results of 22nd camp.
#169692-169715



BS data measured this time

Isotope effects on plasma confinement properties and nonlinear interaction of multi-scale turbulence in LHD (Y. Xu, W. Li, J. Cheng, M. Kobayashi, S. Ohdachi, A. Shimizu)

Experimental conditions: (R_{ax}, B_t) = (3.60 m, 2.75 , CCW), γ = 1.2538, and B_q = 100 %, #176297-176315

Motivation and objective: Investigate the impact of the isotope mass on characteristics of edge turbulence, turbulent transport, edge radial electric field etc. as well as the nonlinear interaction of multi-scale turbulence in different isotope H/D rich plasmas using GPI, reflectometer and PCI diagnostics, etc.

Results:

- Hydrogen plasmas were produced by NBI heating and ECRH with power and density scan. The shot list is in the table 1. These are the data set to be compared with the deuterium plasmas in 2 Nov. 2021, as shown in Fig. 2 (next page).
- The gas puff imaging data at the edge region were obtained (Fig.1).

GPI data (#176305)

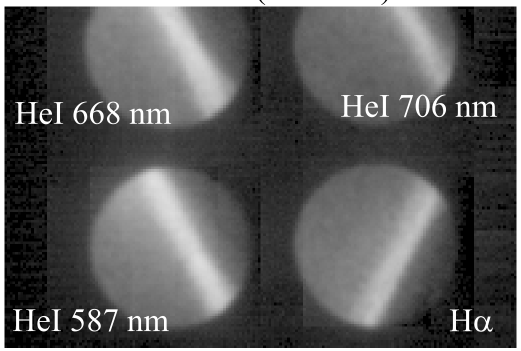


Fig.1: GPI data

Table 1: Shot list in 13. Jan

Shot	P_{NBI} (MW)	P_{ECH} (MW)	$\bar{n}_e$ (10^{19} m^{-3})	Discharge plasma conditions
176297/8	~11.0	~3.6	1.5	H dominant
176303			2.5	
176304			3.5	
176305			4.5	
176312	~7.5	~3.6	1.5	H dominant
176311			2.5	
176304/176313			3.5	
176310			4.5	
176306	~11.0	/	3 ~ 8	H dominant
176315	~7.5	~3.6	4.0	$n_H + n_D/(n_H + n_D + n_{He})$ = 0.5~1

Isotope effects on plasma confinement properties and nonlinear interaction of multi-scale turbulence in LHD (Y. Xu, W. Li, J. Cheng, M. Kobayashi, S. Ohdachi, A. Shimizu)

#171618 (Deuterium, 2 Nov.) #176305 (Hydrogen, 13 Jan.)

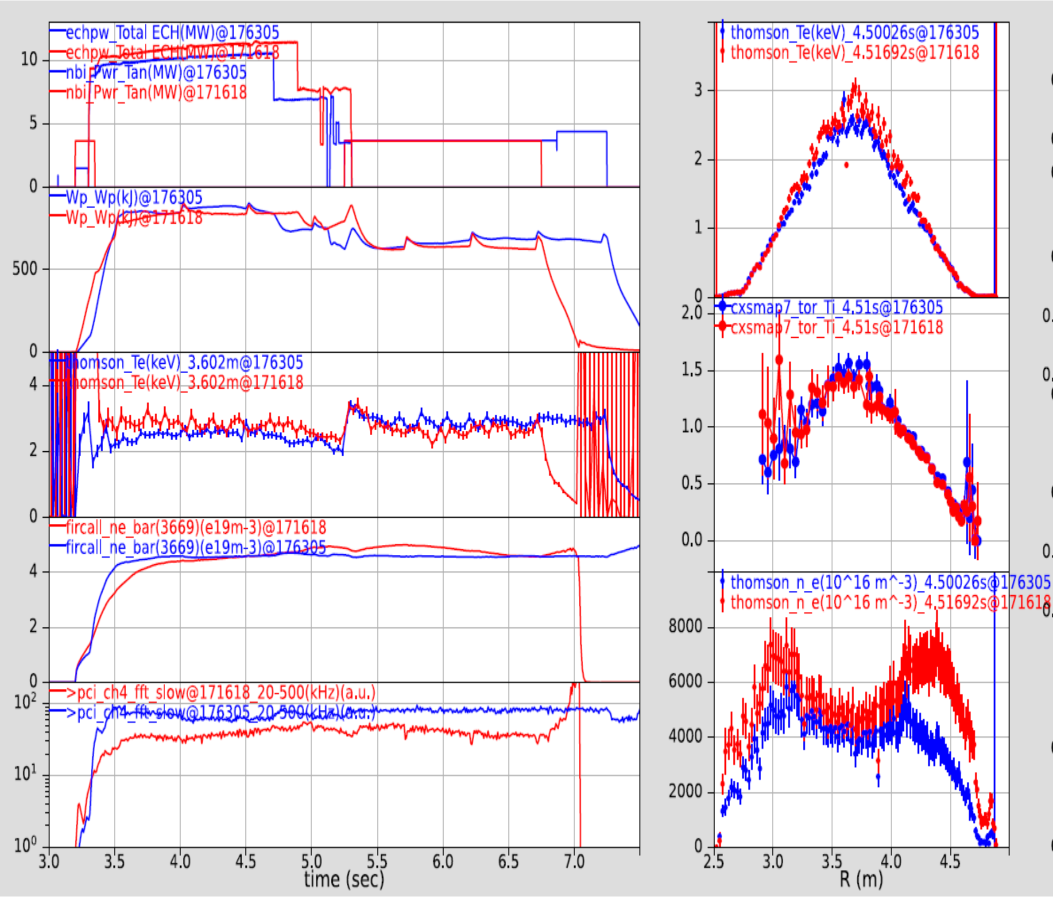


Fig.2: Time traces of deuterium and hydrogen plasmas

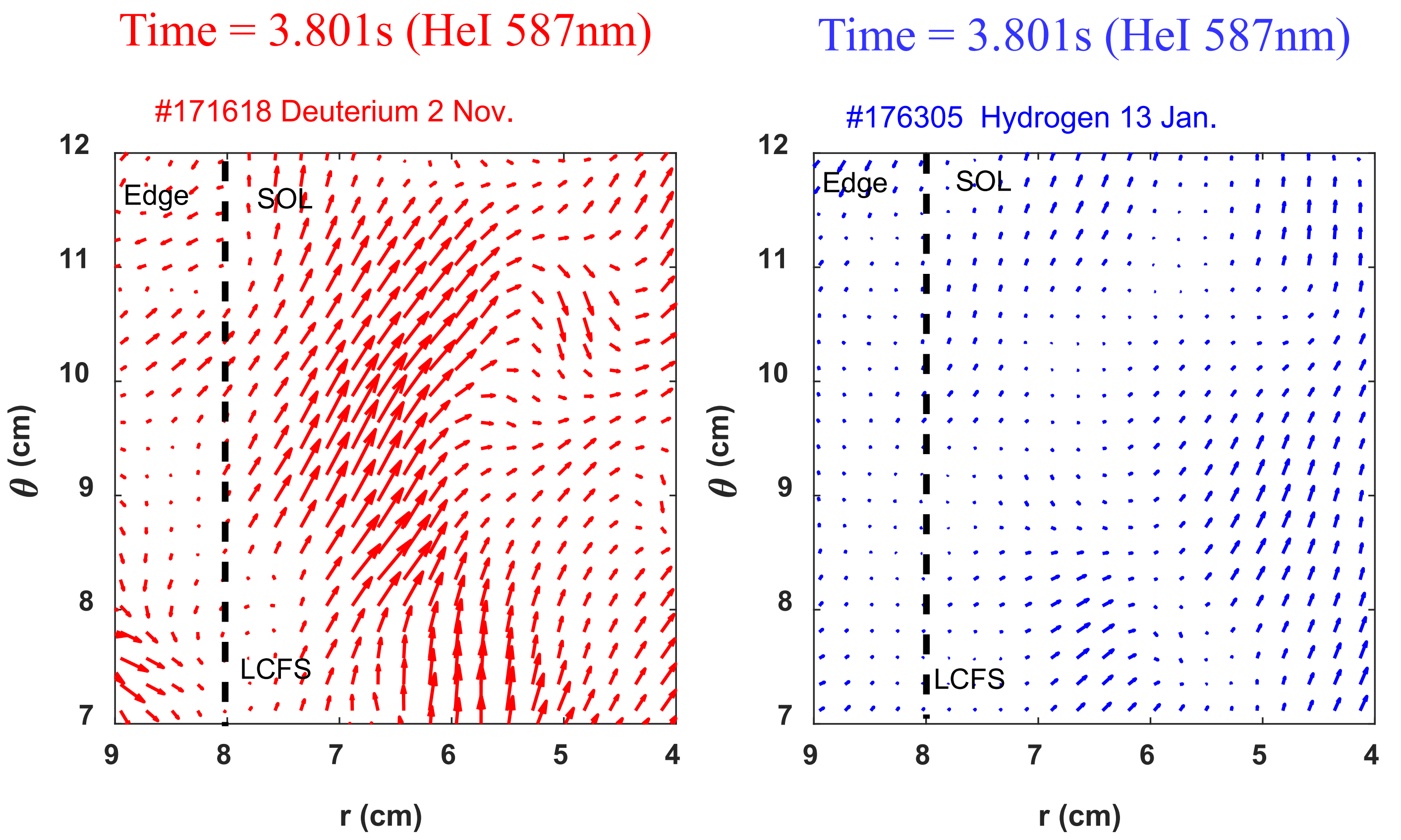
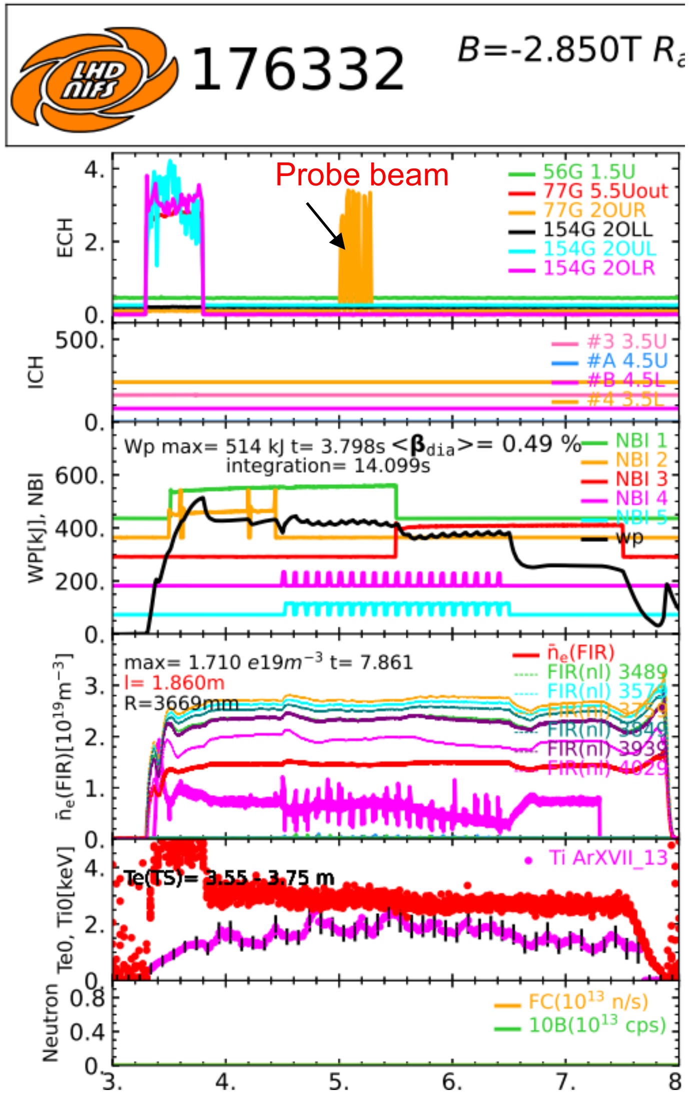


Fig.3: Flow field obtained from GPI of deuterium & hydrogen plasmas

- Flow field can be obtained by the GPI data and being compared between #171618 (Deuterium, 2 Nov.) and #176305 (Hydrogen, 13 Jan.) in Fig.3.
- The initial analysis of GPI data shows flow velocity in Deuterium plasmas is larger than that in Hydrogen plasmas in SOL. More detailed analyses will be conducted later.

5D-velocity space tomography for fast ions (M. Nishiura, D. Moseev(IPP), R. Yanai, N. Kenmochi)

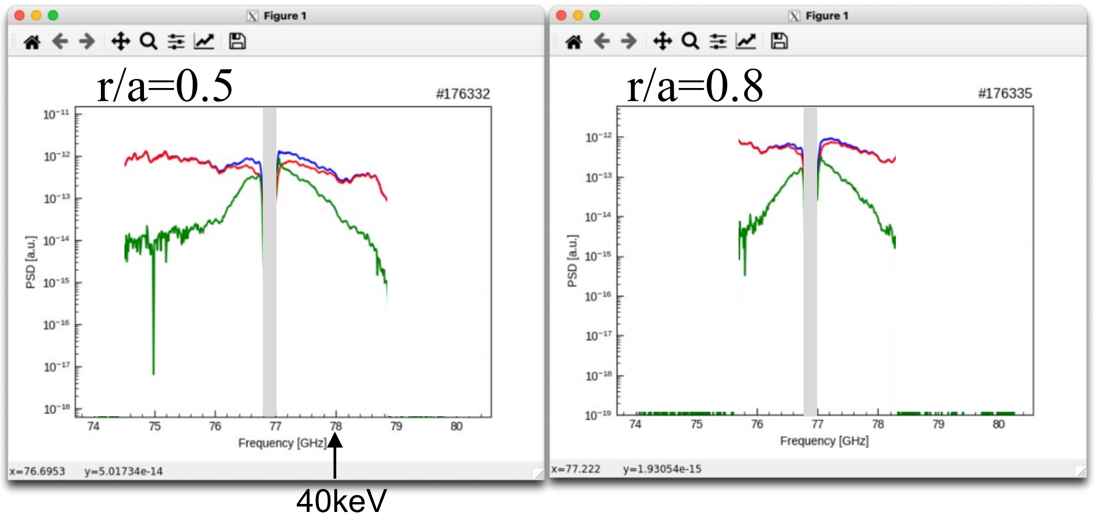


Experimental conditions: (R_{ax}, B_t) = (3.6 m, 2.85, CCW), γ = 1.2538, and B_q = 100 %, #176316-42

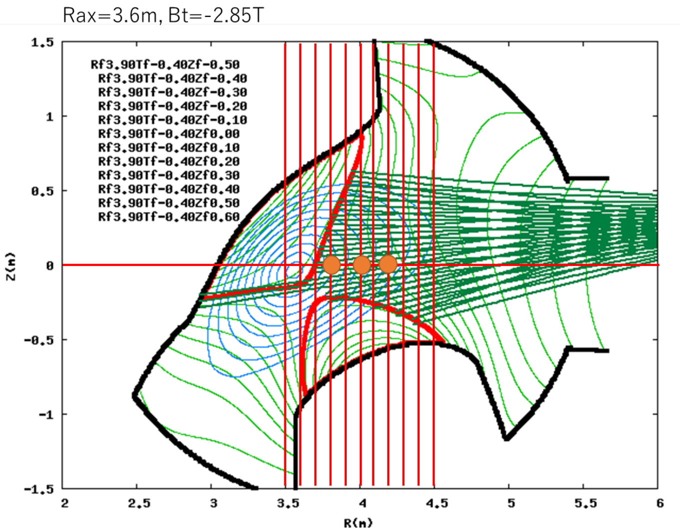
Motivation and objective: Fast ions were measured by CTS, FIDA, and neutron diagnostics. Those data are combined for a tomographic inversion to reconstruct bulk and fast ion distribution on the velocity space.

Results:

- We have measured the fast ions and their spatial profiles in deuterium plasmas by CTS(Dec. 8, 2021). The comparable data were obtained in hydrogen plasmas.
- The probe beam (2O-UR) was modulated to subtract the ECE background. The receive beam (2O-LL) was overlaped at several radial locations.
- Clear difference in the fast ion tail is observed at r/a=0.5 and 0.8(see below).



CTS spectra (CTS+ECE:blue, ECE:red, CTS:green) at two radial location.



Location measured by CTS