(TG2) Turbulence Topical Group Report

Date: Nov. 23, 2022 Nov. 24, 2022 (T. Tokuzawa)
Time: 9:30 - 18:45
Shot#: 184100 – 184249 (150 shots)
Prior wall conditioning: D2 glow Divertor pump: ON
Gas puff: D2, Ar Pellet: None IPD: None
NBI#(1, 2, 3, 4, 5)=gas(D, D, D, D, D)=P(2.1, 2.3, 2.3, 6.8, 7.8)MW

ECH(77GHz)=ant(5.5-Uout (or 1.5U), 2-OUR)=P(703, -)kW
ECH(154GHz)=ant(2-OLL, 2-OUL , 2-OLR)=P(723, 1012, 986)kW
ECH(56GHz)=ant(1.5U)=P(-)kW
ICH(3.5U, 3.5L, 4.5U, 4.5L)=P(- , - , - , -)MW
Neutron yield integrated over the experiment = 1.3×10^{17}

Remarks

The pellet injector failed and could not be used in the experiment.

Topics

1. META-Stellarator: Comparison of scale-down LHD with H-J (S. Inagaki)
2. Isotope effects on plasma confinement properties and nonlinear interaction of multi-scale turbulence in LHD (J. Cheng, M. Kobayashi)
3. Effect of magnetic islands on the bootstrap current in LHD/ Study of the effect of the inversion of the magnetic shear on the e-ITB performance in stellarators with controlling the rotational transform by ECCD and NBCD (A.Dinklage, H. Igami)
4. ~~Feed-forward of high performance conditions in pellet fuelled plasmas(A.Dinklage, R. Sakamoto)~~

META-Stellarator: Comparison of scale-down LHD with H-J (S. Inagaki and Y. Suzuki)

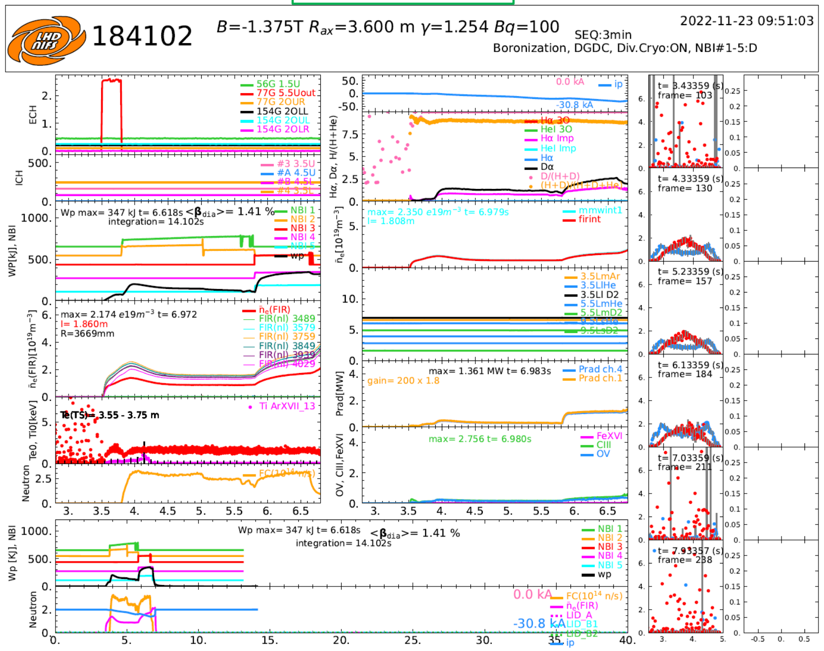
Experimental conditions: (R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CW, 1.375 T, 1.2538, 100 %) #184100 – #184131
(R_{ax}, Polarity, B_t, γ, B_q) = (3.9 m, CW, 1.375 T, 1.2538, 100 %) #184132 – #184150

Motivation and objective: To understand radial heat transport in magnetic confined plasmas, we compare the heat transport properties of Heliotron J and LHD. To understand heat transport as a relationship between heat flux and temperature gradient, the heating power is scanned and the temperature gradient formed is observed. The characteristics of heat transport are then discussed based on how the temperature gradient formed by the same heat flux differs between LHD and H-J. Considering the difference between the major and plasma radii (R, a), the heating power at LHD is about 9 times higher than that at Heliotron J to provide the same heat flux. (1.8-4.5 MW is required at LHD to provide stable 0.2-0.5 kW injection for ECH and NBI, respectively, at Heliotron J). The magnetic field was set to 1.375 T to be as similar as possible to Heliotron J (1.25 T), and the line averaged density was set to 1x10^{19} m^{-3}. To see the effect of the effective helical ripple, the magnetic axes were set to 3.6 m and 3.9 m.

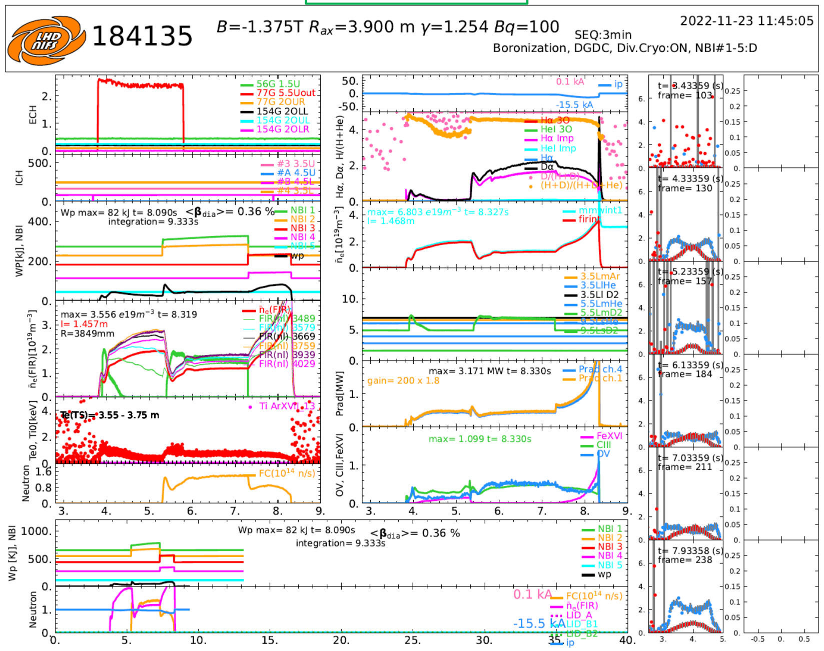
Results:

- We successfully scanned the ECH and NBI powers (ECH only, NBI (#1 single ion souce), …, ECH + NBI (#1+#2+#3) under stational density conditions.

R_{ax}=3.6m



R_{ax}=3.9m



Measurements of turbulence in H/D plasmas (J Cheng and Y Xu and M. Kobayashi)

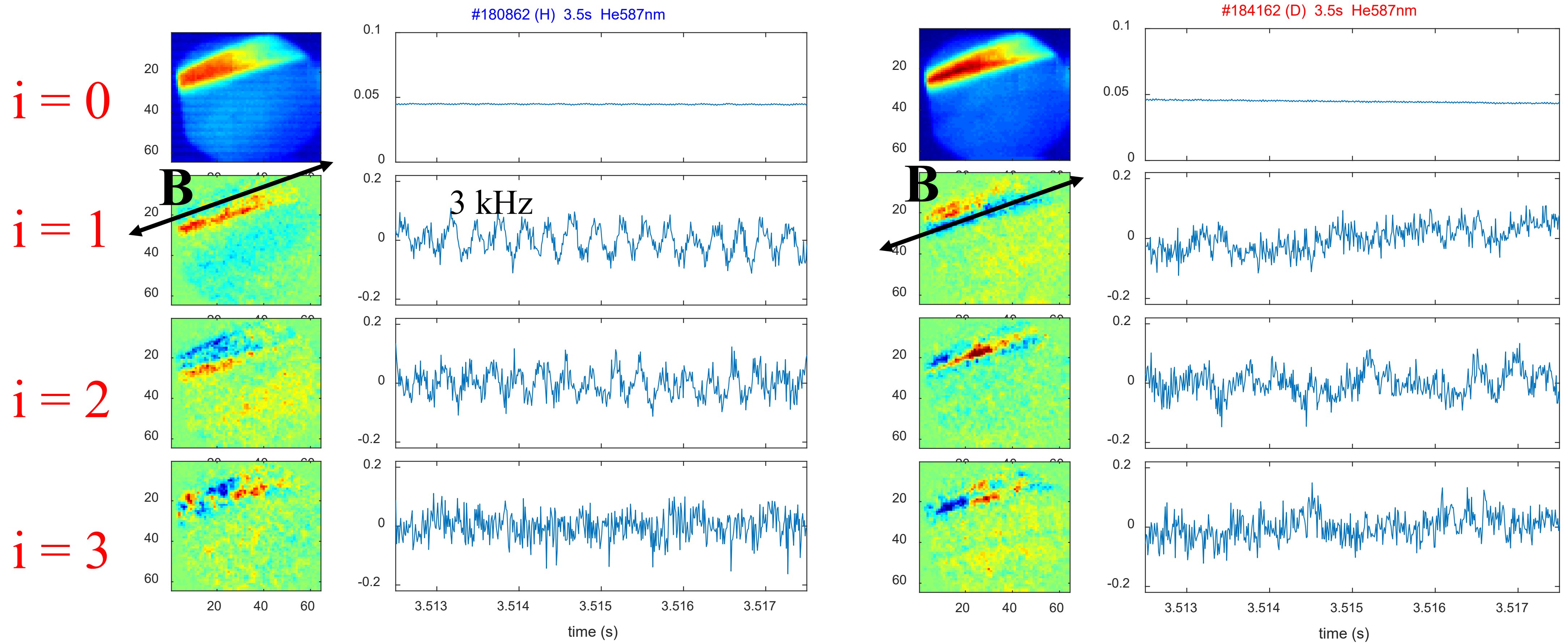
Shot #: 184151 – 184191 (effective shots: 35)

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

Motivation and objective: Isotope effects on plasma confinement properties and nonlinear interaction of multi-scale turbulence in LHD .

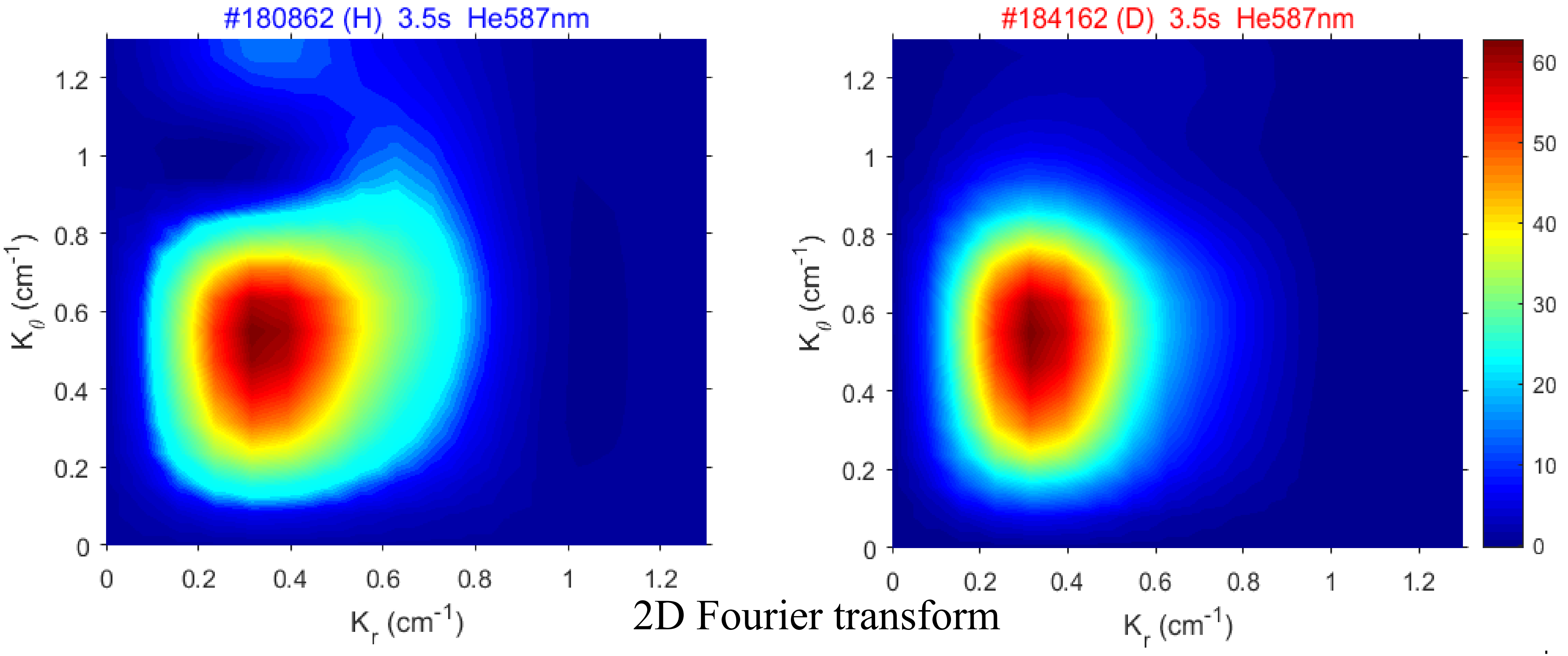
Results:

- We successfully obtain clear decomposition of fluctuations by using Singular Value Decomposition (perpendicular and parallel components to magnetic filed) in GPI data. There is a mode with frequency around 3kHz in H plasmas.



2D Fourier transform has been used to obtain the wavenumber (K) spectrum.
It shows that in H plasmas the eddy structure is smaller (radial correlation length $l \sim 1/K$) than that in D plasmas which is consistent with previous results.

■ $l_r(D) > l_r(H) \quad l_\theta(D) \approx l_\theta(H)$



2D Fourier transform

We will further analyze our data later and look forward for the results.

Study of the effect of the inversion of the magnetic shear on the e-ITB performance in stellarators with controlling the rotational transform by ECCD and NBCD

Shot #: 184191 – 184249

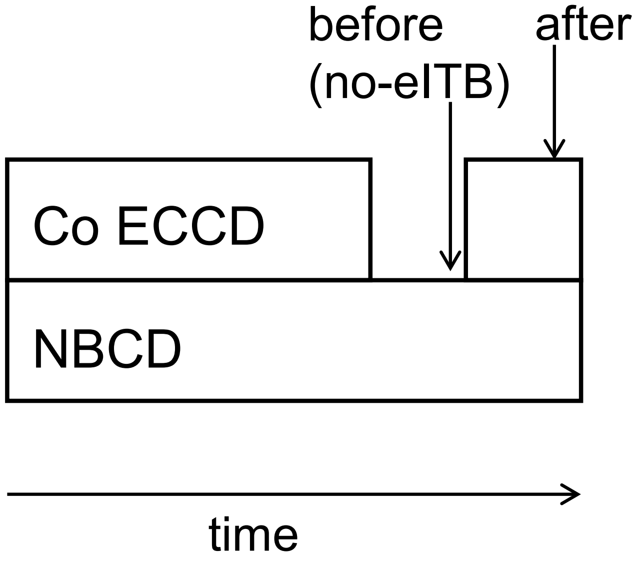
(H. Igami, A. Dinklage, B. Hjoerdus, et. al)

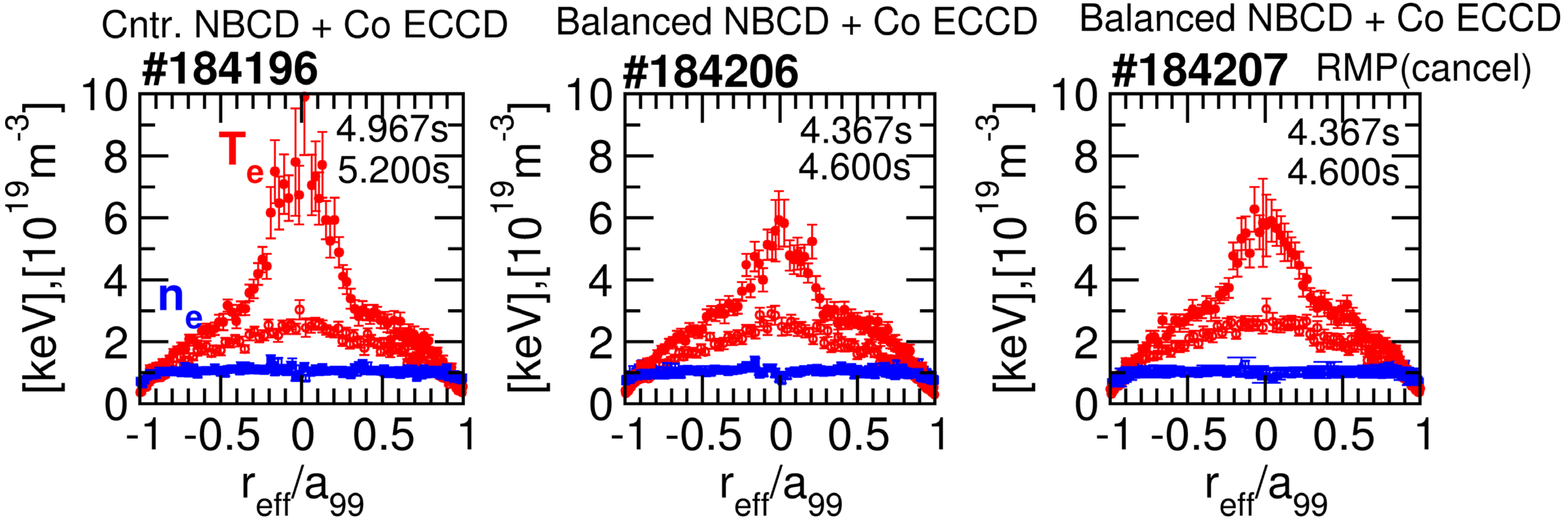
Experimental conditions: (R_{ax}, Polarity, B_t, γ, B_q) =
(3.6 m, CCW, 2.75 T, 1.2538, 100 %), (3.8 m, CCW, 2.70 T, 1.2538, 100 %),

Purpose: To investigate the effect of the background $\iota/2\pi$ profile on the "formation mechanism" of the e-ITB

Results:

- The profile of the rotational transform was controlled by combination of NBCD and Co ECCD
- To vanish the e-ITB from the target plasma, Co ECCD was once turned off, then the second co ECCD was superimposed to investigate the characteristics of e-ITB formation at different rotational transform profiles
- Different T_e profiles were obtained at 200 ms from the start of the second ECCD
- Rotational transform profile from MSE measurement, electric field and flow from CXS measurement will be checked





Research Proposal 24/002632: Effect of magnetic islands on the bootstrap current in LHD

Debriefing of Experiments Nov.23, 2022

Dinklage, Igami, Tamura, Albert, Bouvain, Ida, Markl, Satake,Takezawa, Yoshinuma and the LHD Experiment Team

Wendelstein 7-X

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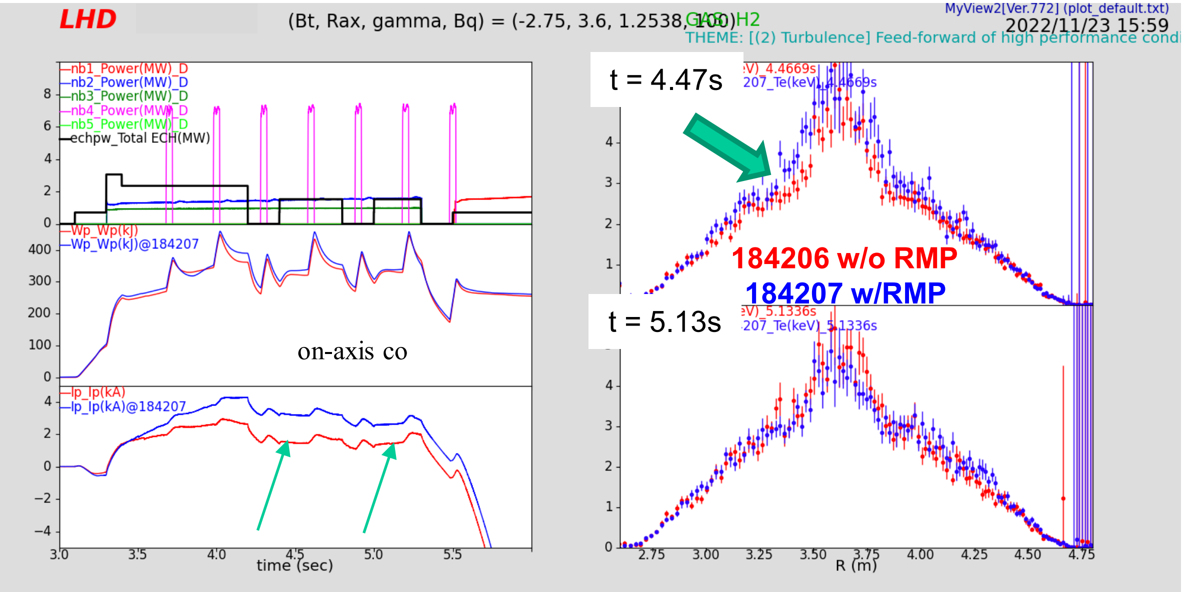
Report on Research Proposal 24/002632 (Nov.23,2022)

Aim of the experiment:

Investigate effect of magnetic islands on bootstrap current

Complementary study with eITB transition program (Igami)



- **islands (RMP case) lead to smaller plasma current**
- ECCD leads to a compensation of the RMP effect in T_e (see t=5.13s comparison)
- Modelling (t.b.d.): does flattening alone explain the island effect?