(TG2) Turbulence Topical Group Report

Nov. 16, 2022 (M. Nishiura)

Date: Nov. 15, 2022
Time: 9:50-18:45
Shot#: 183287-183449
Prior wall conditioning: NO
Divertor pump: ON
Gas puff: H2, D2, He, Ar
Pellet: Li2TiO3, CaAlO4, SiB6, NaCl
NBI#(1, 2, 3, 4, 5)=gas(D, D, D, D, D)=P(2.1, 2.7, 2.5, 6.6, 5.9)MW
ECH(77GHz)=ant(5.5-Uout (or 1.5U), 2-OUR)=P(0.703, 0.792)MW
ECH(154GHz)=ant(2-OLL, 2-OUL, 2-OLR)=P(0.723, 0.799, 0.825)MW
ECH(56GHz)=ant(1.5U)=P(-)MW
ICH(3.5U, 3.5L, 4.5U, 4.5L)=P(0.83, 0.56, 0.81, -)MW
Neutron yield integrated over the experiment = 1.2×10^{17}

Topics

1. Effect of flow bifurcation on turbulence penetration and transport within a magnetic island(L. Bardoczi)
2. Potential and density fluctuation measurement in e-ITB to study isotope effect(A. Shimizu)
3. Effects of multi-ion and the magnetic field structure on non-local transport(N. Kenmochi)
4. Robustness assessment of methods to prevent an impurity accumulation in D＆H-NBI-heated plasmas(N. Tamura)

Robustness Assessment of Methods to Prevent an Impurity Accumulation (N. Tamura et al.)

Magnetic Configuration: (R_{ax}, Polarity, B_t, γ, B_q) = (3.60 m, CW, 2.75 T, 1.2538, 100.0%)

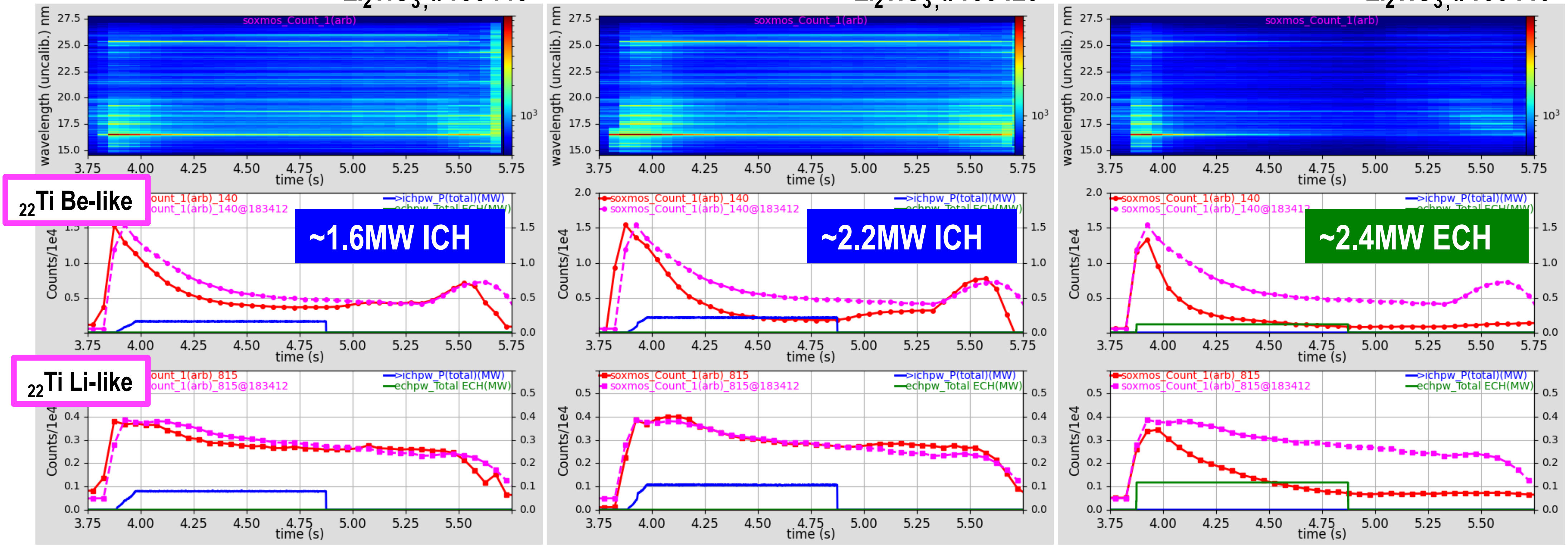
Shots: 183409-183449

Goal of this experiment: We investigate the applicability of schemes (ECH/ICH) to prevent impurity accumulation in the core region of LHD plasmas for different Z impurities

Main results of this experiment

- We have injected TESPELs containing compound tracers (**Li_2TiO_3, $CaAlO_4$, SiB_6, NaCl**) to study a (lower-Z sided) Z-dependence of the impurity transport, and We have applied **154 GHz ECH** or **ICH** additionally (t = 3.875 s – 4.875 s, for 1.0 s) immediately after the TESPEL injection (t = 3.825 s)
- **A clear difference in the effect of ECH and ICH on impurity transport was observed**

Li_2TiO_3, #183445 | Li_2TiO_3, #183429 | Li_2TiO_3, #183446



ICH effect

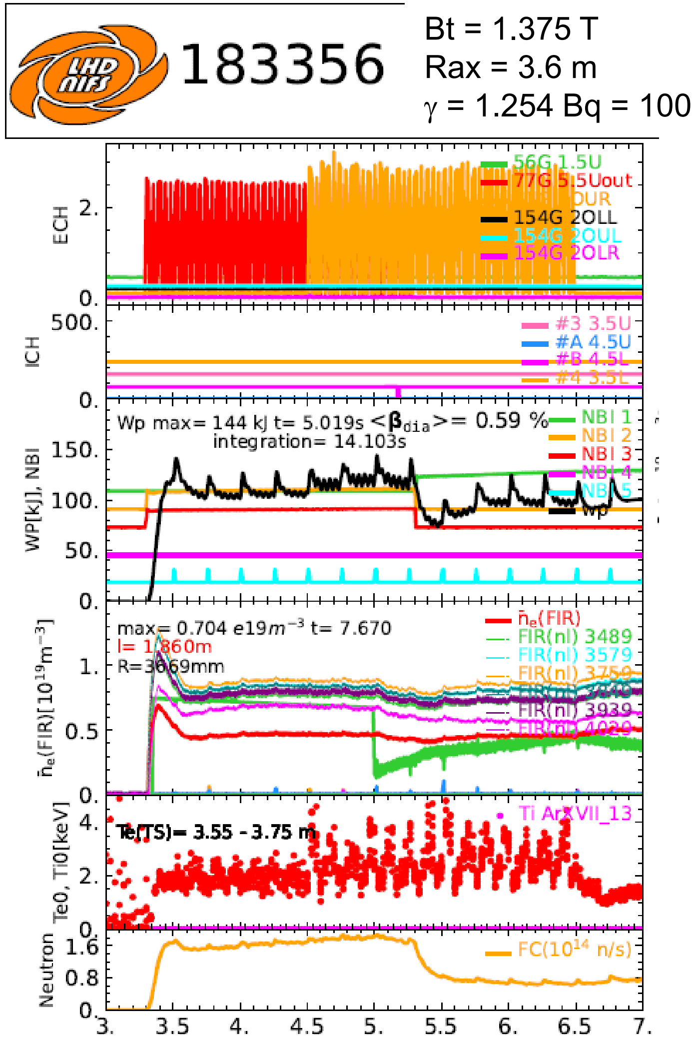
- A power dependence appeared in the time evolution of Ti Be-like
- Almost no effect appeared on the higher charge state, Ti Li-like

ECH effect

- The effect appeared on both charge states, Ti Be-like and Ti Li-like

Potential and density fluctuation measurement in e-ITB to study isotope effect

A. Shimizu, M. Nishiura, Nov. 15 2022



Experimental Condition

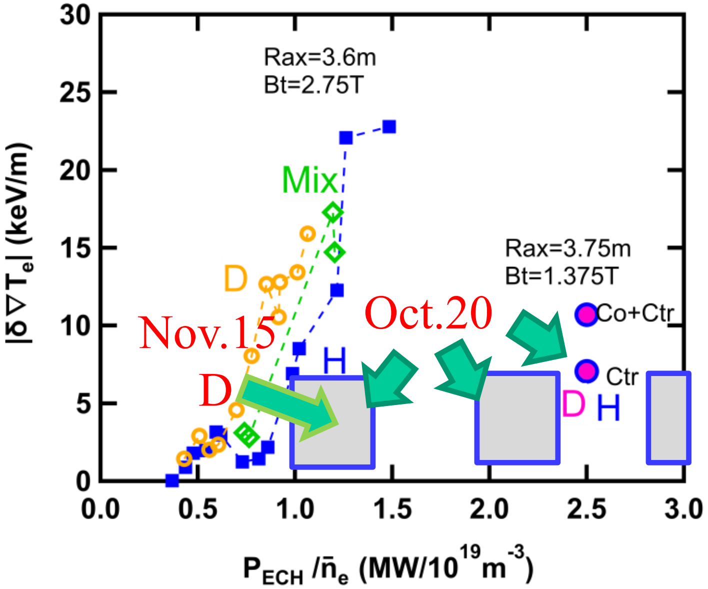
- #183336 - # 183351 (Rax=3.75m, Bt=1.375T, gamma=1.254, Bq=100%)
- #183352 - # 183358 (Rax=3.6 m, Bt=1.375T, gamma=1.254, Bq=100%)

Background and objective

- HIBP measures a plasma potential with e-ITB to study isotope effect. The threshold power to form the e-ITB for D discharge is lower than that for H[T. Kobayashi Sci. Rep. 2022]. On the condition of P_{ECH}/n_e ~ 1.4, we obtained data of D discharge.

Results

- Temperature profiles between H (Oct.20) and D (Nov.15) are slightly different. Density profiles are different.
- The electric potential profiles were obtained to estimate Er.



Temperature profile during ECH modulation

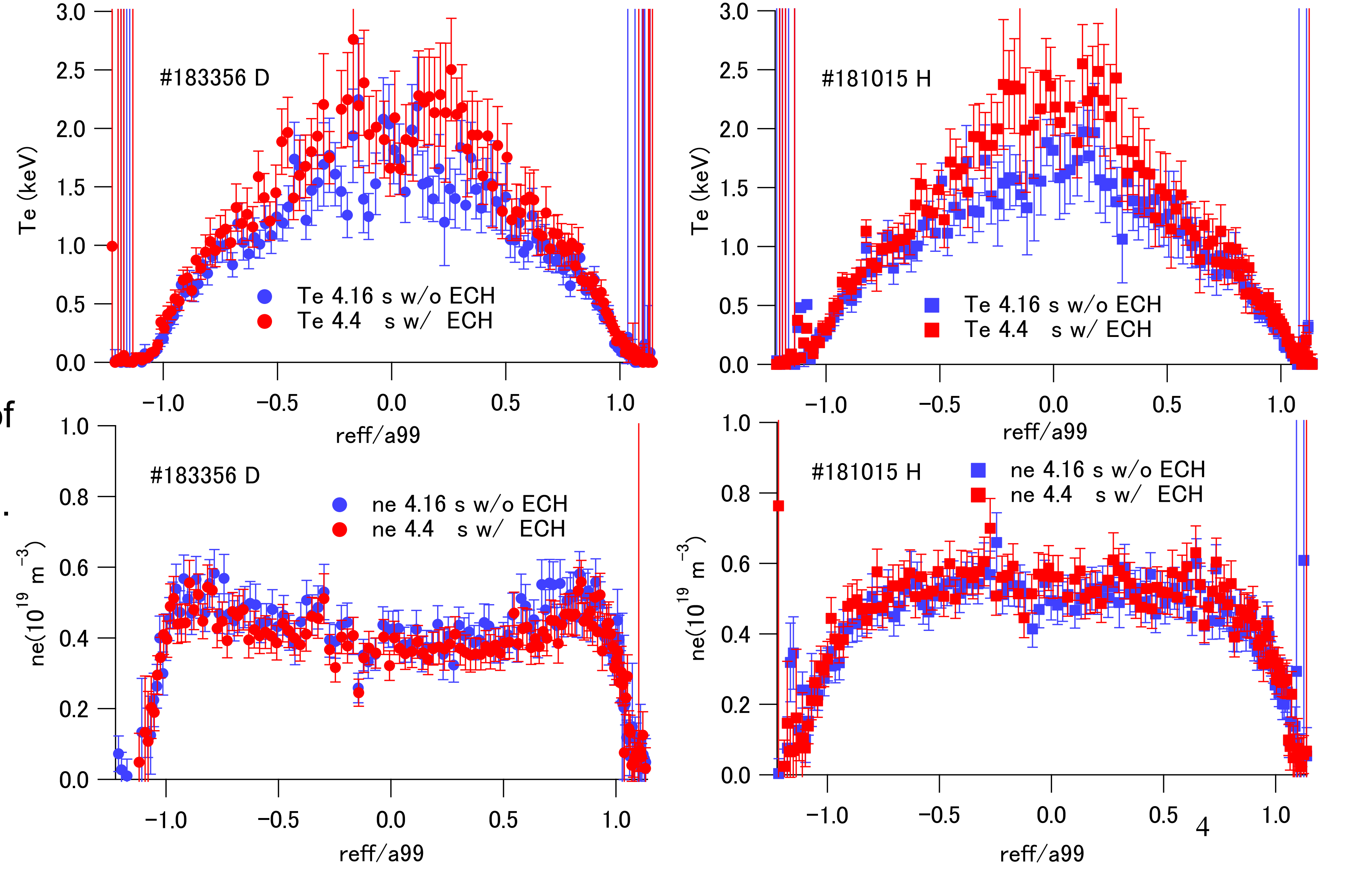
Results

- D experiments at the same input power and line averaged density (~0.5 x 10^{19} m^{-3}) of previous H experiments were performed.
- In density profile, clear difference appears. In electron temperature profile, the width of Te profile in D discharge is slightly larger than H discharge.
- We will check potential profile difference between these two cases by using conditioning average technique.

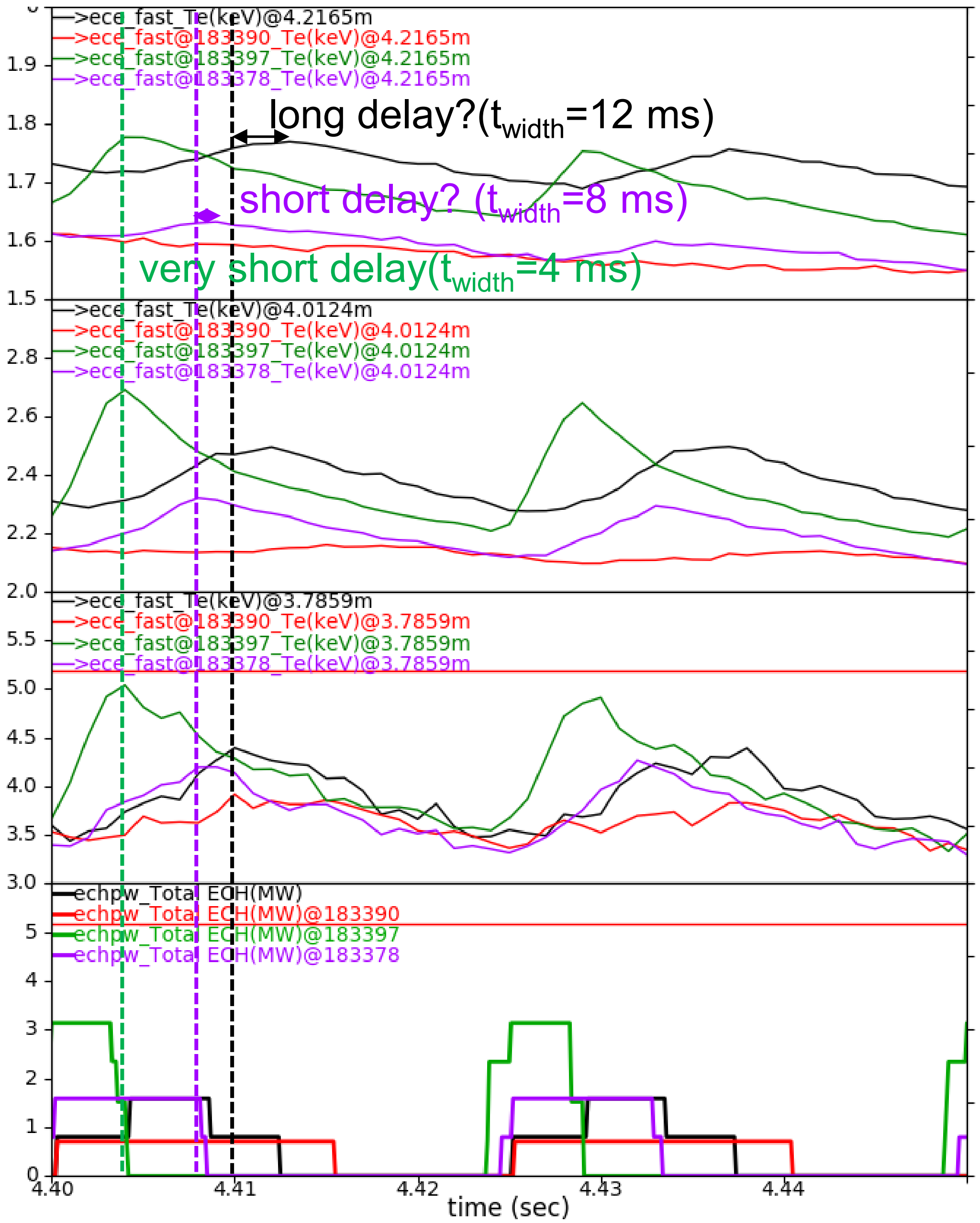
Rax=3.6 m, Bt=1.375T, gamma=1.254, Bq=100%

Nov. 15 2022, D discharge

Oct. 20 2022, H discharge



Effects of multi-ion and the magnetic field structure on non-local transport (N. Kenmochi)



Shot #: 183359 – 183408 (50 shots)

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

Motivation and objective:

- ✓ It is demonstrated that the avalanche events with a short time scale propagated faster than those with a long time scale [Politzer+PoP2002, Kenmochi+Scientific Reports2022].
- ✓ Experiments were conducted in which the incident pulse width was varied with constant incident energy by changing the time width and power of the modulated ECH.
- ✓ This methods allowed us to investigate the effect of the thermal pulse width on its propagation velocity systematically.

Results:

- ➢ Electron heating with constant incident energy with pulse widths(t_{width}) of 4, 8, 12, and 16 ms has been achieved.
- ➢ It is possible that the propagation velocity of the thermal pulses is faster in the case of heating with shorter pulse widths.
- ➢ In the future, the differences in propagation velocity will be investigated in detail using the conditional averaging technique.
- ➢ Since BS and HIBP have also been measured, the effect of the width of the thermal pulse on the propagation velocity of turbulence will also be investigated.

Effect of flow bifurcation on turbulence penetration and transport within a magnetic island

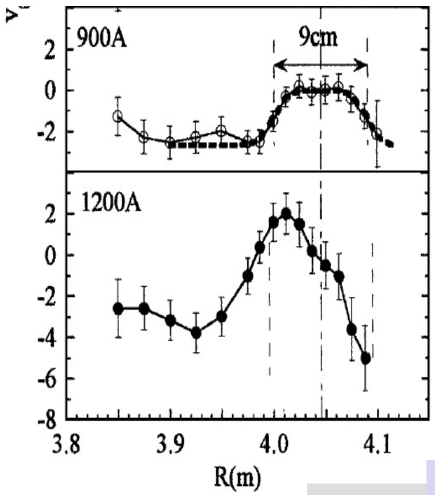
L. Bardoczi with K. Ida, Tokihiko Tokuzawa, Mikirou Yoshinuma, Tatsuya Kobayashi

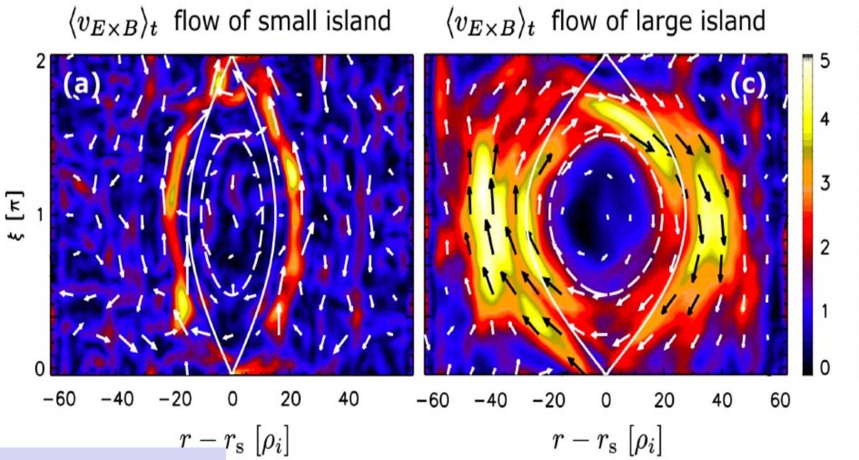
Shot #: 183290 - 183335

Exp. conditions: R_{ax}=3.55m, B_t=1.375T γ=1.254, B_q=100.

Background: Parity of flow around magnetic island bifurcates from even to odd [K. Ida PRL 2001], consistent with vortex flow formation in Gyrokinetic simulations [A. B. Navarro 2017 PoP]. Turbulence suppression and penetration are important for NTM stability in tokamaks [L. Bardoczi PRL 2016, K. Ida PRL 2018].

Objective: Investigate the impact of flow bifurcation on turbulence penetration into the magnetic island, compare to Gyrokinetic simulations.





Results:

- Accomplished LID coil current scan (600A-3000A) which varied the magnetic island width.
- Observed T_e flattening and n_e peaking in the magnetic island.
- Acquired poloidal and toroidal flow data as well as turbulence density fluctuation data. [new]
- Flipped coil current phase to check difference in turbulence and flow between X-point and O-point. [new]
- Varied NBI setting to modify plasma flow around the magnetic island.
- Next steps: careful analysis of flow & turbulence data including X-point reflectometer data [new]. Compare to Gyrokinetic simulations. [new]