(MAP) Session Report

Date: Apr. 18, 2024

Apr. 19, 2024 (C. Suzuki)

Time: 12:25 – 16:43
Shot#: 189830 – 189898 (69 shots)
Prior wall conditioning: H_2 glow
Divertor pump: ON
Gas puff: H_2
Pellet: Si, W, Cu, Ti, Mo

NBI#(1, 2, 3, 4, 5) = gas(H, H, H, H, H)=P(4.6, 4.5, 4.3, 3.7, 2.7) MW
ECH(77GHz) = ant(1.5-Uo, 5.5-U, 2-OUR)=P(-, 0.70, 0.38) MW
ECH(154GHz) = ant(2-OLL, 2-OUL, 2-OLR)=P(0.71, 0.89, 0.98) MW
ICH(3.5U, 3.5L, 4.5U, 4.5L) = P(-, -, -, -) MW

Topics

1. Calibration of Solar EUV Spectrometers and Validation of Diagnostic Capability for Solar High- Temperature Plasmas by LHD Experiments (H. Hara (NAOJ), I. Murakami)
2. Transport analysis of heavy impurity ions in core plasma (S. Satake)
3. Study of the impact of turbulence reduction via boron injection on impurity confinement and transport (D. M. Roque (Ciemat), N. Tamura)

Si TESPEL Injection for emission line diagnostics

H. Hara, Murakami, I., Kato, D., C. Suzuki, T. Kawate, N. Tamura et al.

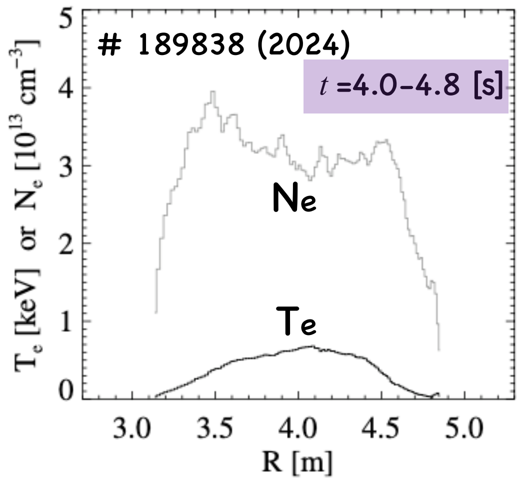
Objectives:

- Validation of plasma diagnostic capability by Si emission line ratios for studying the solar corona

* SiN contained TESPEL injections executed

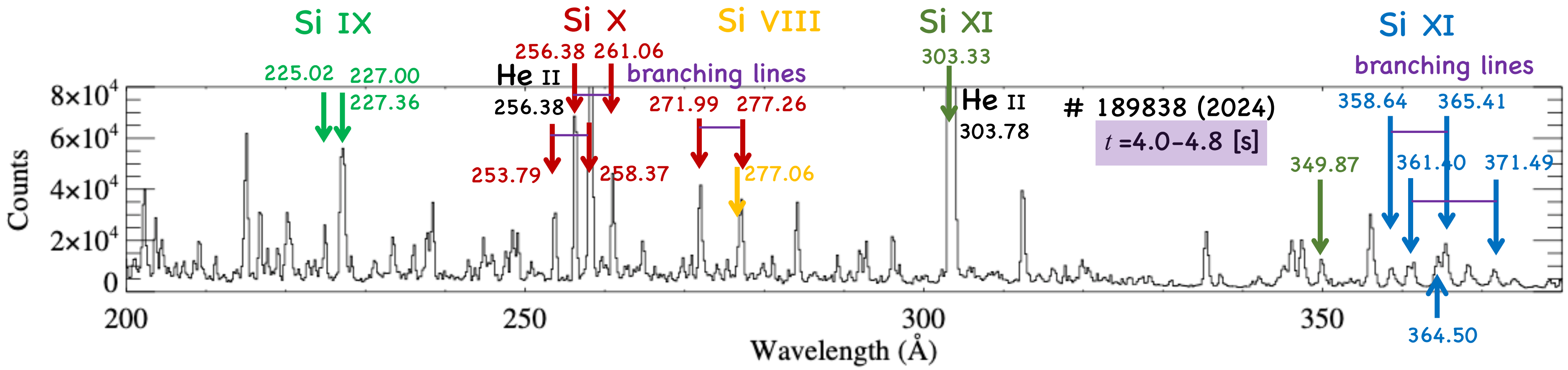
Experimental Conditions:

- H gas, R_{ax}=3.9m, Bt=-1T, γ=1.254, Bq=100
- Si contained TESPEL injection at 3.95 sec
- #189831-#189840 (10 shots)



Results:

- We have detected target Si X lines with Si VII, Si VIII, Si IX, and Si XI lines.
- These are to be used for the on-orbit spectrometer calibration by branching lines and plasma diagnosis by density-sensitive line pairs of Si and other elements.



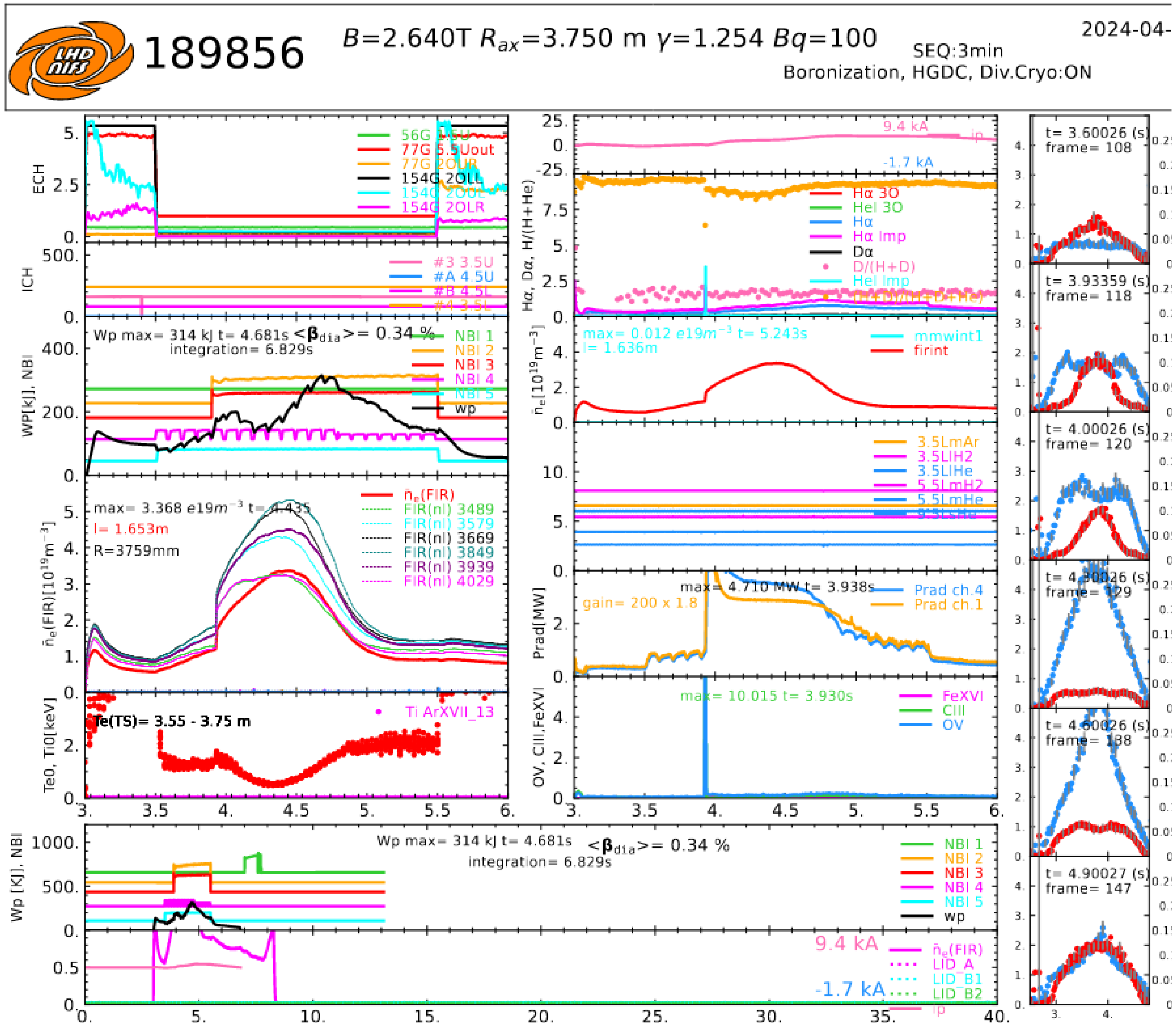
Objective of the experiment

Before LHD shutdown, obtain the experiment data of plasma with W impurity so that we can analyze the transport process of heavy impurity species in the future.

Operation

- Plasma : Rax=3.75, Bax=2.64, γ =1.2538 , CW
- Pellet : W 0.1 ϕ x 0.7, C 0.7 ϕ -0.25 ϕ $(5\sim7\times10^{17}$ W atoms)
- Diagnostics : HIBP (core-Er), Visible & EUV spectrometers (W impurity profile)

- W pellet was injected and tangential NBIs turned on at t=3.9
- Without NBI#1, ne peaking was observed ($n_e(center)\sim 5e19$) and then suddenly began to decrease from t=4.6s.
- Te dropped from 1.5 to 0.5keV end increased again as ne decreases.
- From n_e profile & radiation power, W appears to have accumulated in the center once and then turned to exhale.
- Precise W profile from spectrometer will be analyzed later.



2024/4/18 “Transport analysis of heavy impurity ions in core plasma” S. Satake (NIFS) (2)

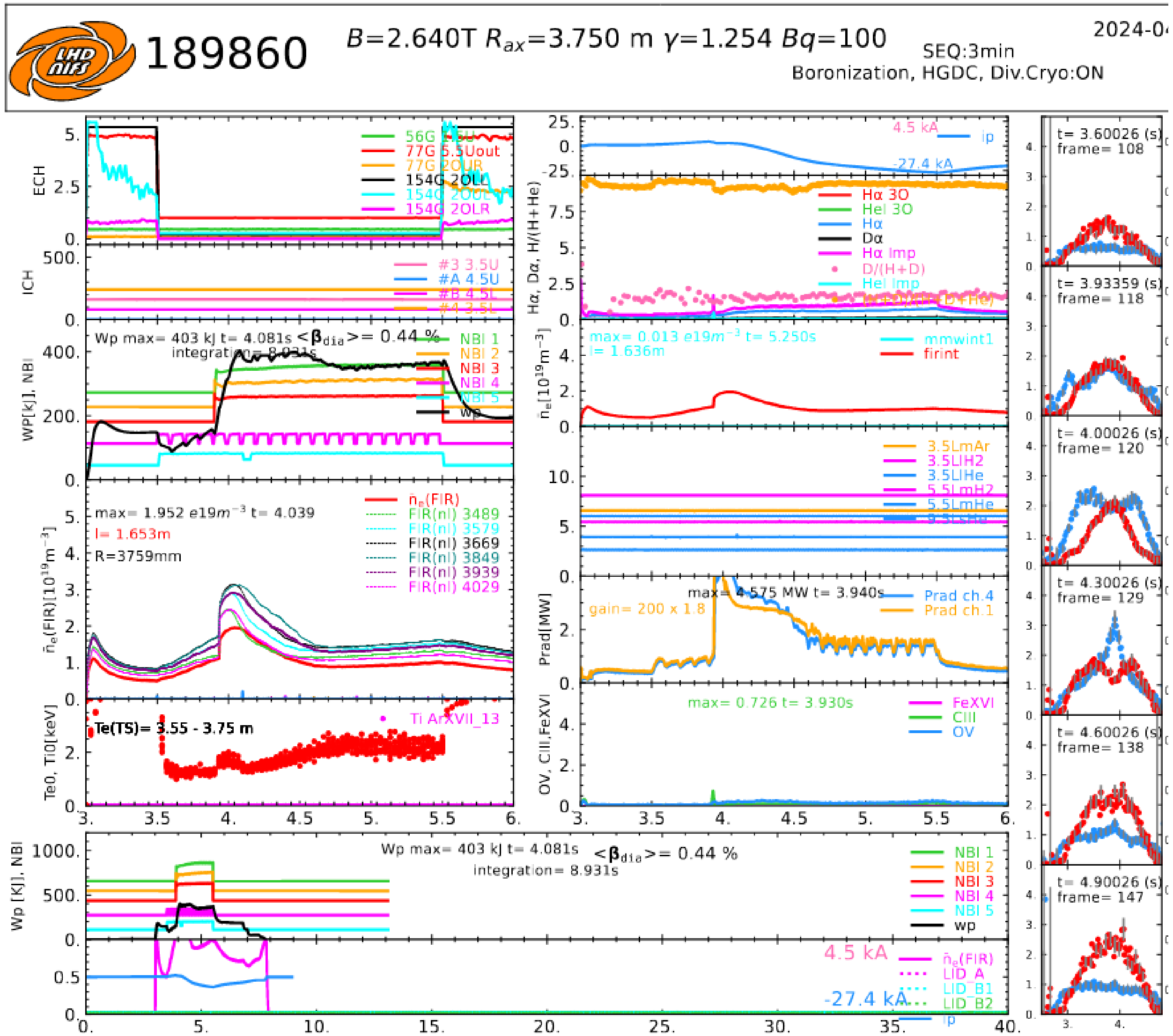
- When NBI#1 was added , core n_e did not increased so much ($n_e(center) \sim 3e19$). Strong NBI heating seemed to prevent the accumulation of pellet-oriented electrons to the plasma center (and probably W, too).

- Note that n&T profiles @ t=3.9 – 4.1 s was similar to the shot w/o NBI#1. Difference appeared b/w two shots appeared from t=4.1.

- n_e profile became very peaky @ t=4.3, where hollow-T_e was also observed. Probably core T_e was dropped because of radiation loss by W which was accumulated around the magnetic axis. Ti was about 2.0keV at the center, which was slightly higher (1.5keV) in the shot w/o NBI#1.

- Soon after peaked-n_e profile was formed, n_e began to decay and T_e increased.

- There is a delay between the start timing of n_e drop (t=4.2s) and radiation drop (t=4.4s). → reflect the difference in the radial flux of electron and tungsten?



Study of the impact of turbulence reduction via boron (lithium) injection on impurity confinement and transport (D. Medina Roque, N. Tamura, I. García Cortés, K. J. McCarthy, F. Nespoli et al.)

Magnetic configuration: (R_{ax}, Polarity, B_t, γ, B_q) = (3,6 m, CW, 2.75 T, 1.2538, 100.0%)
Shots: #189879 - #189898

Goal of this experiment

- Characterize Z-Dependence of the impurity confinement and transport with TESPEL injections in the turbulence-reduced phase during the Li injection with the IPD.
- Obtain data for comparisons with future results in W7-X and TJ-II.

Background & Motivation

- In Nespoli Nat. Phys 2022 it was shown that significant B injection with the IPD triggers a turbulence-reduced and confinement-improved phase. But an study of the behavior of the impurities in this scenario remains outstanding. This is of great interest, since when the turbulence level is strongly reduced, neoclassical impurity transport could be of higher importance and the Z-Dependence of impurity transport should be observed.
  - ✓ Estimate an impurity decay time from the line intensity evolution for injected elements (**Ti, Cu, and Mo**) for plasmas w/ and w/o impurity hole using EUV/VUV spectrometer SOXMOS (its wavelength range from 19.7 to 34.1 nm with a 133.6 g/mm grating for Ti, from 14.5 to 27.4 nm with a 133.6 g/mm for Cu, and from 8.9 to 13.2 nm with a 600 g/mm grating for Mo).

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Results

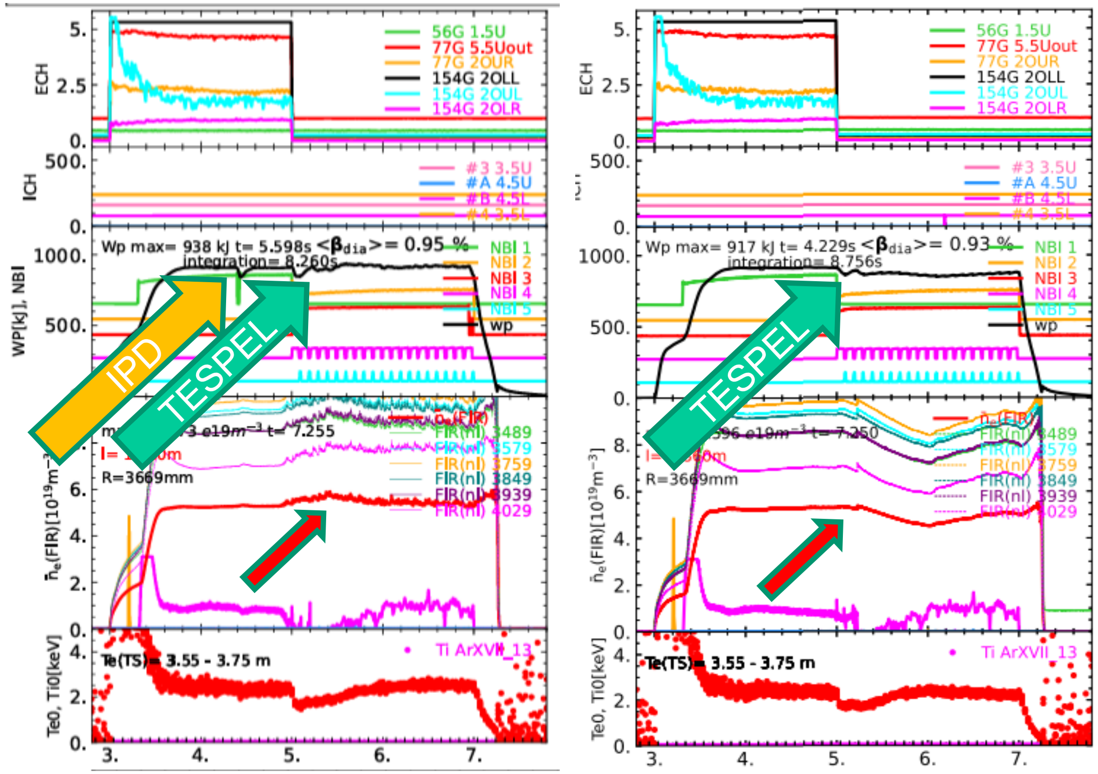
- **15 TESPELs are successfully injected at 5.225s (8 into w/ IPD)** and **(7 into w/o IPD)** at 3.8-6.8s while keeping n_e at 5e19 m^{-3}

  Heating pattern

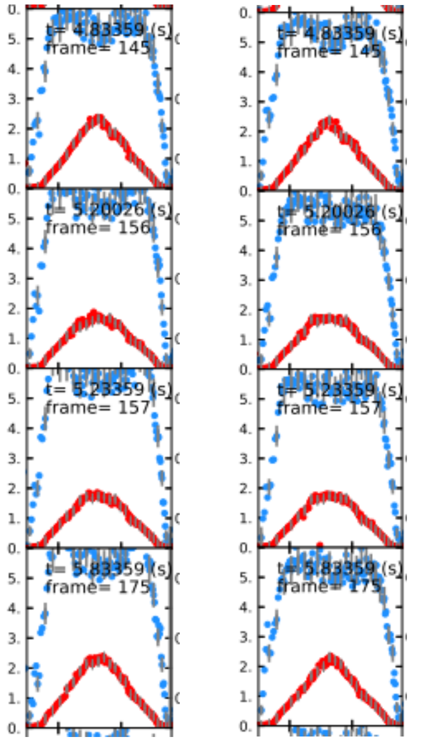
  ECH#1,2,4,5,7(3s-5s) NB#1(3.3s-5s)(t), NB#2,3(5s-7s)(t), NB#4(5s-7s)(p)(80 on/20 off), NB#5(5s-7s)(p)(20 on/80 off)

- We obtained data for all impurities w/ and w/o IPD plasmas.
- Impurity confinement time from SOXMOS signals Er from CXRS and DR and turbulence level from PCI and DR will be analyzed.
- No impurity accumulation is preliminarily from ne and Te

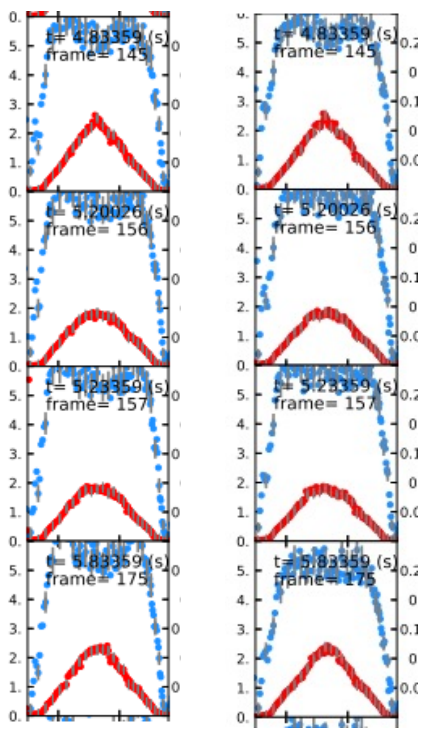
Typ waveforms



Ti IPD (189891) w/o IPD (189893)



Cu IPD (189884) w/o IPD (189887)



Mo IPD (189894) w/o IPD (189896)