

(TG3) Spectroscopy group report



Date: Oct. 5, 2022

Oct. 6, 2022 (T. Kawate)

Time: 13:41 – 16:50

Shot#: 179767 – 179826 (60 shots)

Prior wall conditioning: No

Divertor pump: No

Gas puff: H₂, Ar

Pellet: TESPEL(SiB₆, Fe, W)

NBI#(1, 2, 3, 4, 5)=gas(H, H, H, H, H)=P(3.0, 3.8, -, 5.0, 4.8)MW

ECH(77GHz)=ant(5.5-U, 2-OUR)=P(0.703, 0.792)MW

ECH(154GHz)=ant(2-OLL, 2-OUL, 2-OLR)=P(0.463, 0.601, 0.602)MW

ICH(3.5U, 3.5L, 4.5U, 4.5L)=P(0, 0, 0, 0)MW

Neutron yield integrated over the experiment = 5.2×10^{12}

Topics

1. Impurity Transport for a Wide Range of Various Impurity Species Using TESPEL Injections
(A. Langenberg, N. Tamura)



LHD Experiment Session Report on:

Impurity Transport for a Wide Range of Various Impurity Species Using TESPEL Injections



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A. Langenberg, N. Tamura *et al.*

In LHD and W7-X: Impurity accumulation and non-accumulation scenarios observed [1]

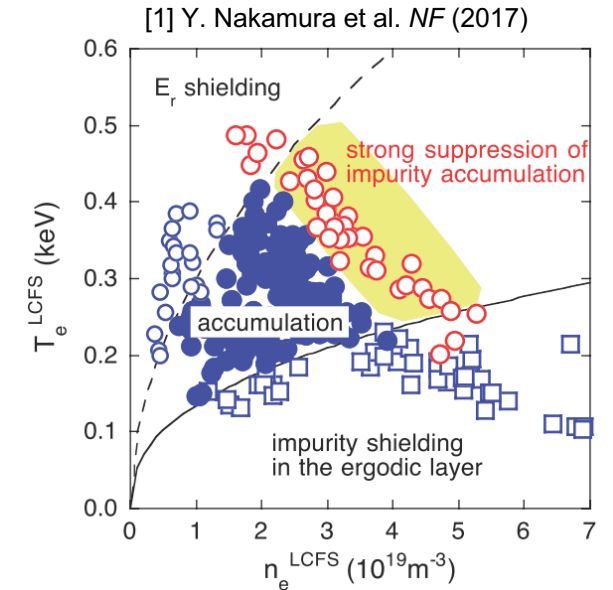
Observations in non-accumulating scenarios (LHD [1,2] and W7-X [3,4])

- No / weak impurity charge Z or mass M dependence
- Absolute $\tau_I \sim 100 - 400 \text{ ms}$

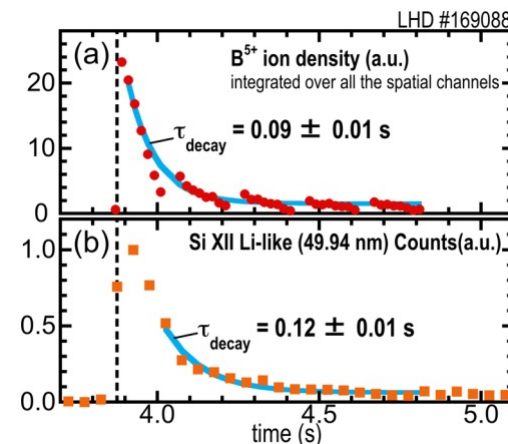
Question: Transition to accumulating scenarios w.r.t. different impurity species?

Experiment: Systematic P_{NBI} , n_e , and Z scans monitoring transport times τ_I in:

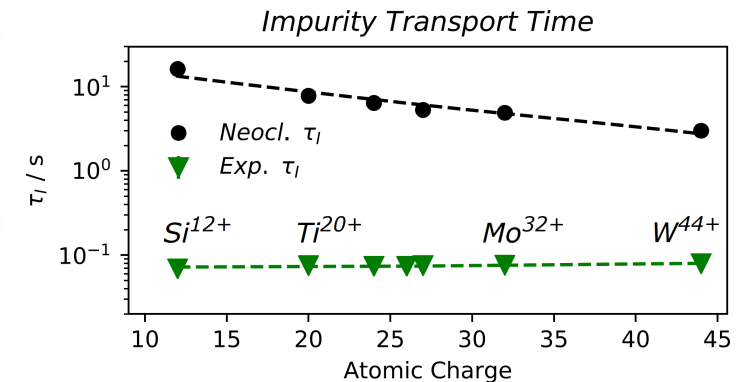
- Accumulation vs. non-accumulation scenarios
- Low vs. medium n_e
- Low vs. high Z impurities (Si to W)



[1] Y. Nakamura, N. Tamura et al. *Nuclear Fusion* (2017)
 [2] N. Tamura, M. Yoshinuma, K. Ida et al. *Plasma and Fusion Research* (2021)
 [3] A. Langenberg, Th. Wegner, N. Pablant et al. *Phys. Plasmas* (2020)
 [4] M. Kubkowska, A. Czarnicka, T. Fornal et al. *Rev. Scient. Instrum.* (2018)



[2] N. Tamura et al. *PFR* (2021)



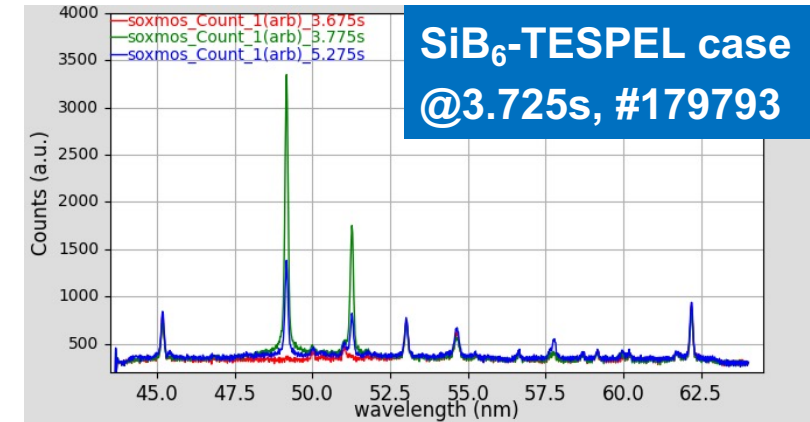
[3] A. Langenberg et al. *PoP* (2020)

General Layout:

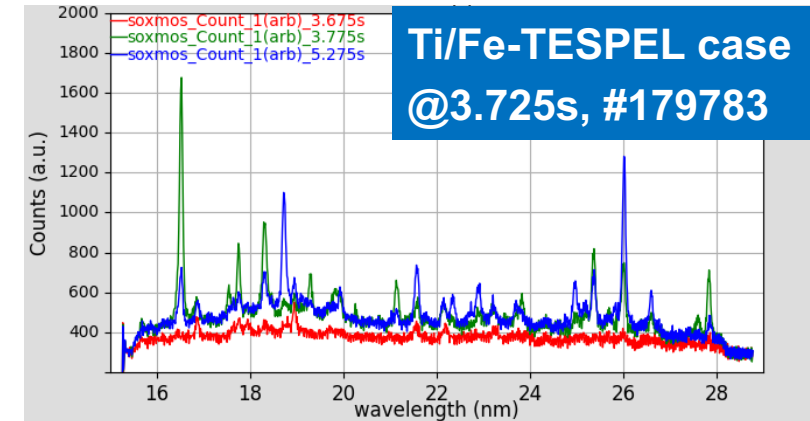
- Total of 60 programs performed with very reliable TESPEL injections (only 1 TESPEL injection failed ← operation mistake)
- Injected impurity species: Si, B, Ti, Fe, and W
- Density range: 1-2 and 4-5 e19 m⁻³
- P_{NBI} = 5-13 MW, 3 different heating schemes; full tang. (#1+#2), half tang. (e.g., #1A+#2B), perp. (#5 + mod. #4) → similar to W7-X OP2.1 (to be performed)

Performance:

- Data of good quality recorded for:
 - ✓ all 5 impurity species
 - ✓ in all three heating scenarios
 - ✓ for both high/low density regions
- Several occasional issues with tripped NBI sources and FIR n_e measurements



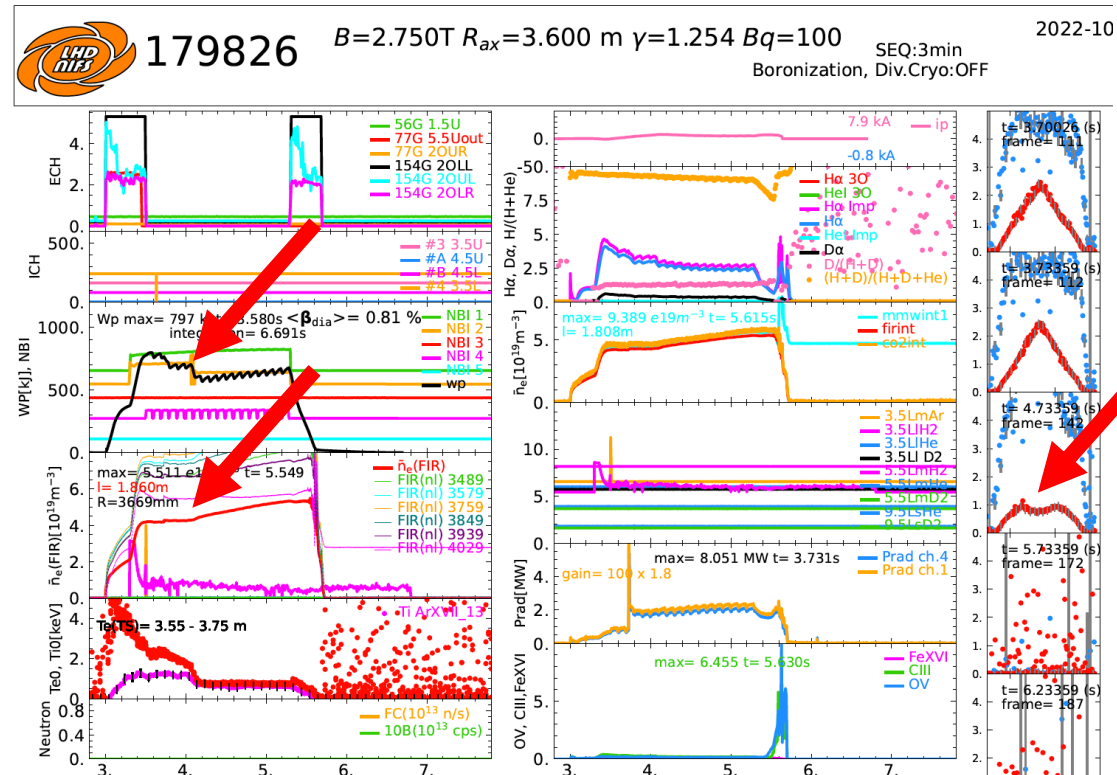
✓ Si Li-like emissions clearly observed



- ✓ Many Ti/Fe line emissions clearly observed
- ✓ W line emissions should be observed (not shown here, noise removal is needed)

Observations:

- Accessed regimes of non- vs. accumulating scenarios (as expected) for W and Ti+Fe impurities (shot numbers e.g. #179779 and #179826)
- Indications of W accumulation observed (hollow T_e profile) after accidental NBI power step down



- More detailed investigation of transport times and density profiles to be done...