

(TG3) Spectroscopy group report

Oct. 26, 2021 (T. Oishi)

Date: Oct. 22, 2021

Time: 9:38 – 11:14, 17:29 – 18:41

Shot#: 170783 – 170815, 170921 – 170944 (57 shots)

Prior wall conditioning: No

Divertor pump: ON

Gas puff: H₂

Pellet: W (Impurity pellet), W, Fe (TESPEL)

NBI#(1, 2, 3, 4, 5)=gas(H, H, H, H, H)=P(3.7, 3.8, 3.6, 3.9, 2.4)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(0.723, 0.715, 0.727)MW

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

Neutron yield integrated over the experiment = 3.1×10^{11}

Topics

1. Study on ion distribution toward low magnetic-field operations (T. Kawate)
2. Expansion of the observable charge state range of tungsten ions (T. Oishi)

Study on ion distribution toward low magnetic-field operations

T. Kawate, T. Oishi, N. Tamura, M. Goto, Y. Kawamoto et al.

Background: To examine science cases and prepare suitable diagnostics for NC-LHD, we need to know the possible parameter space of plasmas of $B < 0.5\text{T}$. Here we focus on impurity transport in a low magnetic field, which allows us to estimate ionization states, available time to trace the impurity ions, etc.

Experimental conditions:

$(R_{ax}, B_t, \gamma, B_q) = (3.6 \text{ m}, -0.458 \text{ T}, 1.254, 100\%)$, H2 gas impurity pellets, TESPEL: Fe, W

Results:

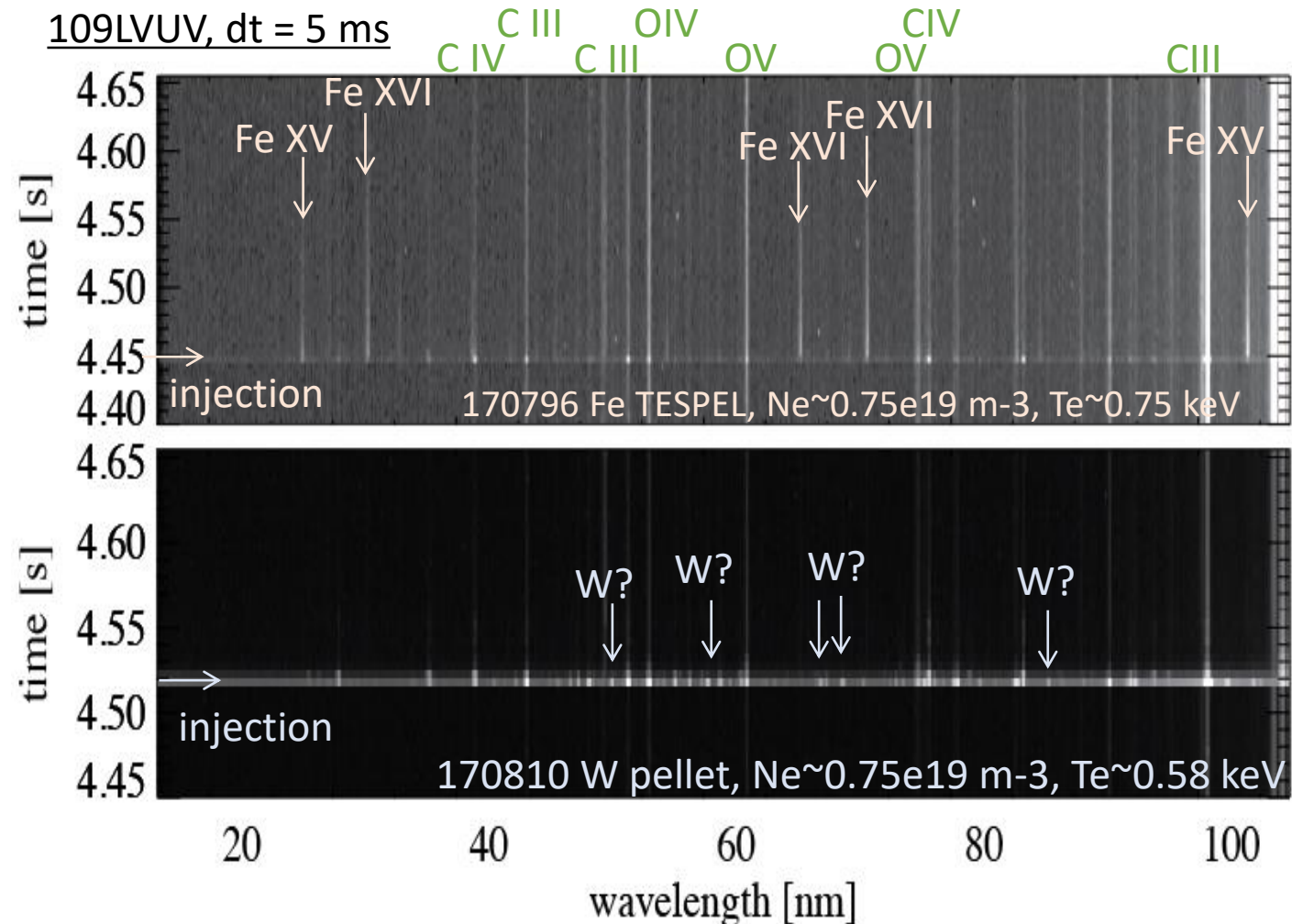
ignition succeeded: 21/32 shots

(only NBI#1: 2/6, only NBI#2: 0/2, NBI#1: 19/21)

$\text{Te}(R=3.60) \sim 0.5\text{-}0.7 \text{ keV}$, $\text{Ne}(R=3.67) \sim 0.7\text{-}2.0 \text{ e}19 \text{ m}^{-3}$

timescale of Prad enhancement just after pellet/TESPEL injection: **0.01-0.02s**

From VUV spectroscopic measurements, Fe XV - XVI lines are identified. We obtained Tungsten(-ish) spectra as well, but need careful investigation to identify the ionization states.



Expansion of the observable charge state range of tungsten ions

Conditions: $R_{ax} = 3.6$ m, $B_t = 2.75$ T, CCW, $\gamma = 1.2538$, $B_q = 100.0$ % #170921-170944 (total 24 shots)

Objective: Emission lines from the neutral atoms, W^0 , to the highly-ionized ions up to W^{46+} have already been observed by spectroscopic diagnostics in a combination with a W pellet injection technique in LHD. In this proposal, the discharge condition is explored to obtain emission data of further higher charge states of W ions, which have not been observed yet.

Results:

- Due to a high injection power of ECH superposition (77GHz x 2 + 154 GHz x 3) after the pellet injection, we accessed high T_{e0} up to 4.5 keV (~3.5 keV in the previous campaign) even though W ions remained in the plasma.
- The EUV spectral shapes are clearly different between high and low T_{e0} cases.
- Identification of the emission lines will be attempted based on the spectral data.
- An extremely hollow electron temperature profile, so-called “electron temperature hole”, was not reproduced. -> to be investigated...

