

# (TG3) Spectroscopy group report



Date: Oct. 21, 2022

Time: 9:57 – 15:07

Shot#: 181113 – 181211 (99 shots)

Prior wall conditioning: NO

Divertor pump: ON

Gas puff: H<sub>2</sub>

Pellet: W (impurity pellet)

Oct. 24, 2022 (T. Oishi)

NBI#(1, 2, 3, 4, 5)=gas(H, H, H, H, H)=P(1.5, 3.6, 3.7, 5.1, 4.3)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, 0.799, 0.825)MW

ICH(3.5U, 3.5L, 4.5U, 4.5L)=P(0.86, 0.78, 0.93, 0)MW

Neutron yield integrated over the experiment =  $9.0 \times 10^{12}$

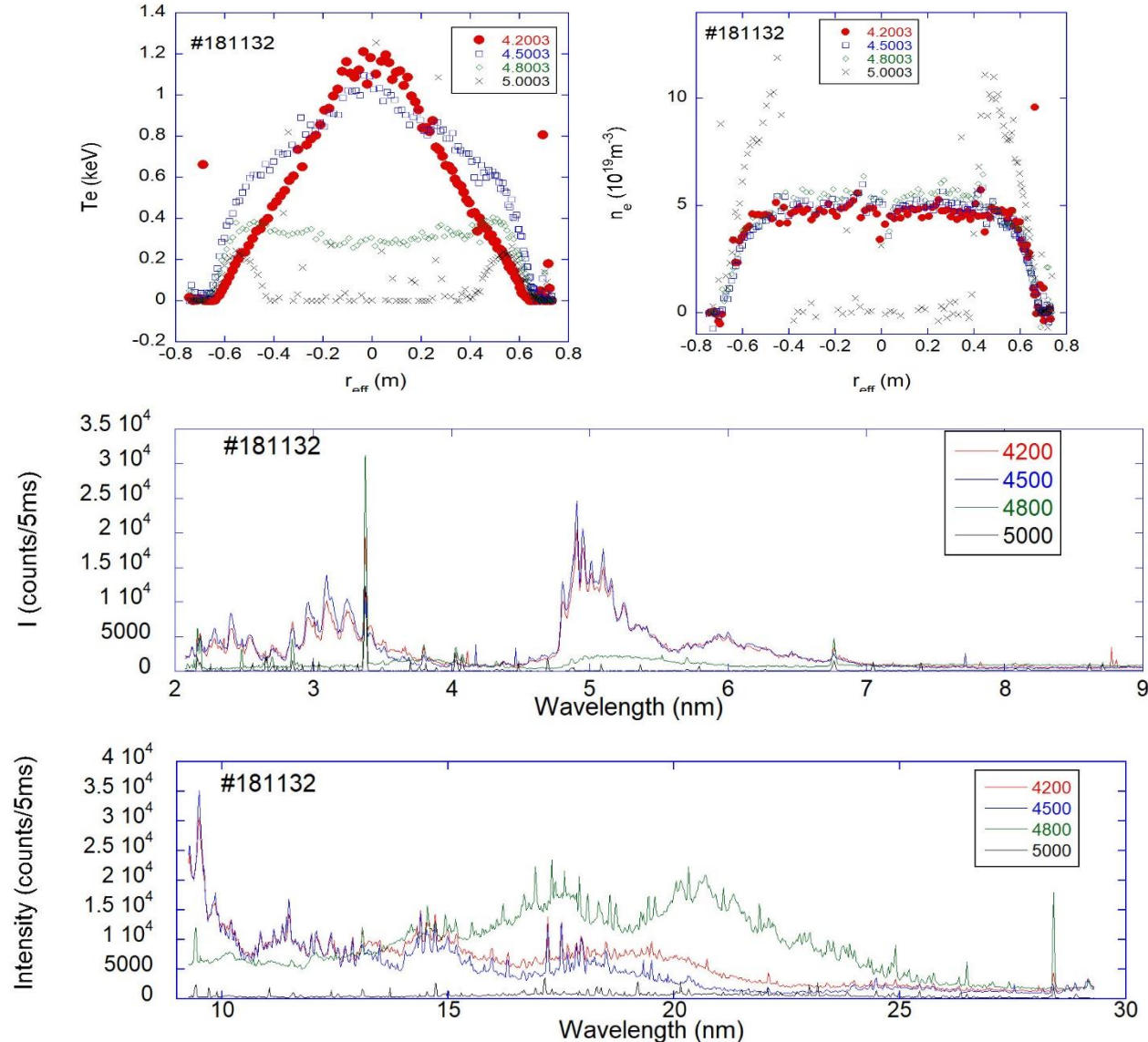
## Topics

1. Simultaneous multi-wavelength spectroscopies for validation on atomic data and spectroscopic modelings for highly charged ions (I. Murakami)
2. Looking for interesting level populations in charge states of Tungsten around W<sup>36+</sup> and possible uses in spectrometer relative intensity calibration (R. Hutton [Beijing Normal Univ.], I. Murakami)
3. Expansion of the observable charge state range of tungsten ions (T. Oishi)

# TG3: “Simultaneous multi-wavelength spectroscopies for validation on atomic data and spectroscopic modellings for highly-charged ions”

I. Murakami, D. Kato, T. Oishi, Y. Kawamoto, T. Kawate, H. A. Sakaue, M. Goto

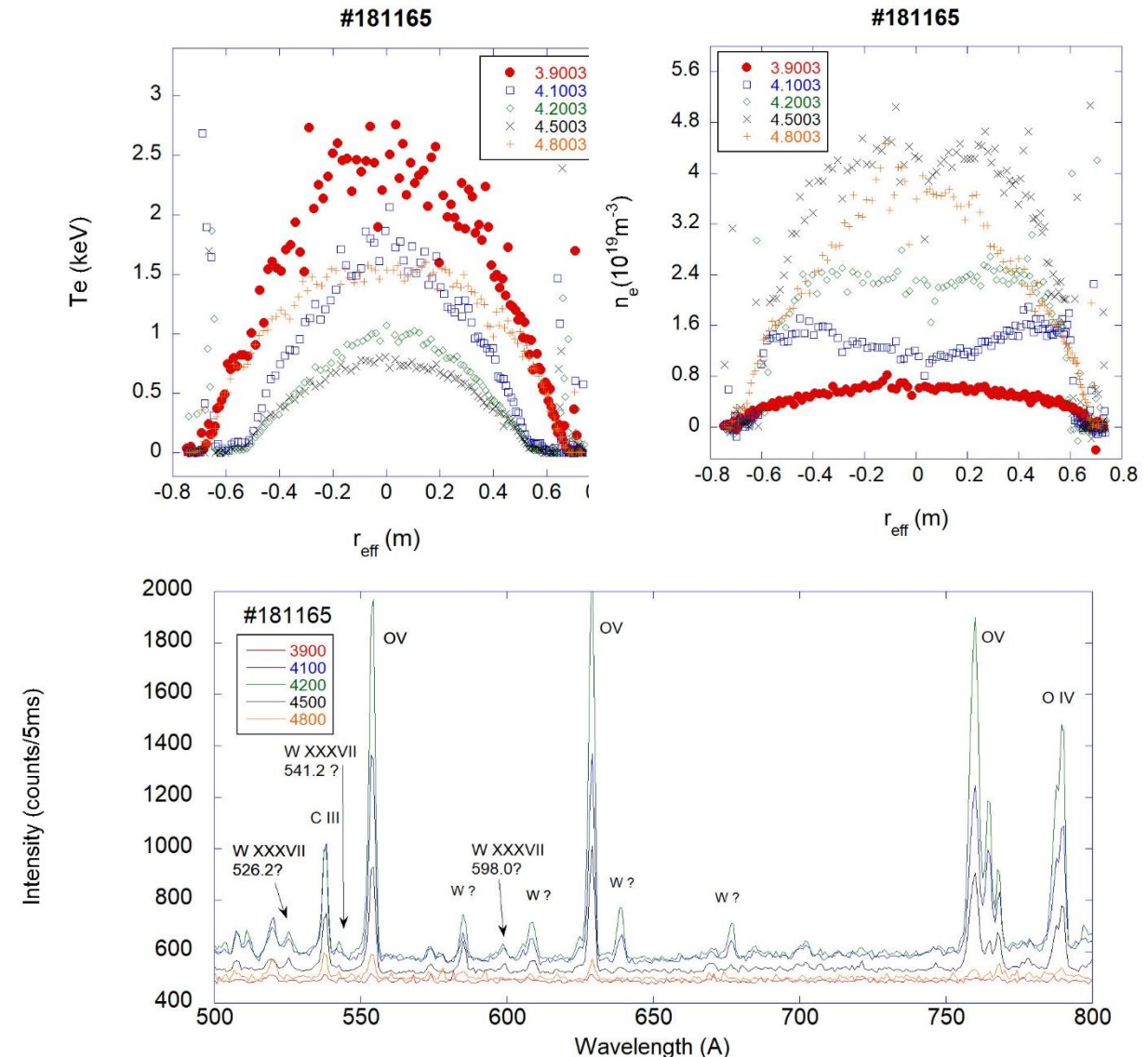
- **Conditions:** #181113-#181142. NBI #1-#5. ECH. H<sub>2</sub> gas. ( $R_{ax}$ , Polarity,  $B_t$ ,  $\gamma$ ,  $B_q$ ) = (3.6 m, CCW, 2.75 T, 1.2538, 100.0%)
- **Objectives:** Spectroscopic model (Collisional-radiative (CR) model) of tungsten ions is to be validated with the measured spectra using LHD, especially for low charged ions.
- **Experiments:** A tungsten impurity pellet was injected at 4.1s. NBI#1-3 were injected at 3.3-5.3s and NBI#4-5 were injected at 5.3-7.3s. EUV spectra at 2.0-9.0 nm and 10-30 nm were measured.
- **Results:** Strong radiation power of accumulated tungsten at core causes temperature hole. Quasi-continuum spectra produced by low charged tungsten ions are measured at 10-30 nm to be compared with calculated spectra after detail analysis.



# TG3: “Looking for interesting level populations in charge states of Tungsten around W36+ and possible uses in spectrometer relative intensity calibration”

R. Hutton, M. Li, I. Murakami, D. Kato, T. Oishi, T. Kawate, Y. Kawamoto

- **Conditions:** #181143-#181170. NBI #1-#5. ECH. H<sub>2</sub> gas. ( $R_{ax}$ , Polarity,  $B_t$ ,  $\gamma$ ,  $B_q$ ) = (3.6 m, CCW, 2.75 T, 1.2538, 100.0%)
- **Objectives:** Look for spectral lines for a few charge states of Tungsten, around W XXXVII to test how levels are populated in hot plasma. Selective population means fewer spectral lines and more use for diagnostics
- **Experiments:** A tungsten impurity pellet was injected at 4.1s. NBI#1-3 were injected at 3.3-5.3s and NBI#4-5 were injected at 5.3-7.3s. VUV spectra at 50-80 nm were measured.
- **Results:** VUV spectra of tungsten were measured. And, candidate lines for W XXXVII are found in the spectra. Detail analysis will be performed. Spectra will be compared to Berlin EBIT spectra taken under more controlled conditions to show if a selective population is seen here, as was in the EBIT



# Expansion of the observable charge state range of tungsten ions

Conditions:  $R_{ax} = 3.6$  m,  $B_t = 2.75$  T, CCW,  $\gamma = 1.2538$ ,  $B_q = 100.0$  % #181171-181208 (total 38 shots)

Objective: Emission lines from the neutral atoms,  $W^0$ , to the highly-ionized ions up to  $W^{46+}$  have been observed by spectroscopic diagnostics over a wide range of wavelength ranges from X-ray to visible light in a combination with a W pellet injection. In this experiment, we aim to identify useful spectral lines for tungsten impurity diagnostics and to obtain emission data of further higher charge states of W ions.

## Results:

- Due to a power of ECH superposition (77GHz x 2 + 154 GHz x 3) after the pellet injection, we accessed high  $T_{e0}$  up to 5.0 keV even though W ions remained in the plasma.
- Identification of the emission lines in such high- $T_e$  discharges will be attempted based on the EUV and X-ray spectral data.

