Date: Oct. 19, 2021
Time: 12:28 – 16:09
Shot#: 170342 – 170412 (71 shots)
Prior wall conditioning: No
Divertor pump: OFF
Gas puff: H₂, He, Ne, Ar, N₂
Pellet: W, Fe, Ni (Impurity pellet), Ce, LaHₓ, Ho (TESPEL)

NBI#(1, 2, 3, 4, 5)=gas(H, H, H, H, H)=P(3.7, 4.4, 3.8, 4.9, 5.1)MW
ECH(77GHz)=ant(5.5-U, 2-OUR)=P(0.45, 0.56)MW
ECH(154GHz)=ant(2-OLL, 2-OUL, 2-OLR)=P(0.40, 0.48, 0.48)MW
ICH(3.5U, 3.5L, 4.5U, 4.5L)=P(0, 0, 0, 0)MW
Neutron yield integrated over the experiment = 1.5 x 10¹²

Topics
1. Simultaneous multi-wavelength spectroscopies for validation on atomic data and spectroscopic modelings for highly-charged ions (I. Murakami)
2. Observation of visible forbidden lines from tungsten highly charged ions (D. Kato)
3. Spectroscopy of highly charged rare-earth ions (F. Koike (Sophia Univ.), C. Suzuki)
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:** #170342-#170375. NBI #1-#5. ECH. H2 gas. ($R_{ax}$, Polarity, $B_t$, $\gamma$, $B_q$) = (3.6 m, CW, 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 4.0s. NBO #1-3 were injected at 3.3-5.3s and NBI#4-5 were injected at 5.3-7.3s. EUV spectra at 2.0-7.7nm and 10-30nm were measured.

- **Results:** Strong radiation power of accumulated tungsten at core caused temperature hole. $W^{6+}$ and $W^{7+}$ lines were observed when the cold hole was producing. Modulating NBI#4 and #5 could sustain plasma when the tungsten accumulation was mild. We first measured ion temperature distribution using CXS7 when electron temperature hole was producing.
TG3: Observation of visible forbidden lines from tungsten highly charged ions

Proponent: D. Kato

Experimental conditions:
\((R_{ax}, \text{Polarity}, B_t, \gamma, B_q) = (3.6 \text{ m}, \text{CW}, 2.75 \text{ T}, 1.2538, 100.0\%), #170342 - #170375, \text{NBI#1-5, ECH, H2 gas}\)

Objectives
Observations of UV-visible lines of W highly charged ions in LHD core plasmas, and identification of the M1 transitions.

Experiments
A tungsten impurity pellet was injected at 4.0s. NBI#1-3 were injected at 3.3-5.3s and NBI#4-5 were injected at 5.3-7.3s.

Preliminary results
Temperature hole was observed at 5.2 - 5.3s. Low Te (< 200eV) plasmas with W content were successfully created. Visible forbidden lines of low charge state W ions will be identified.
Objective: In order to extend the spectral database of rare earth ions to various elements and different wavelength ranges, we try to measure EUV spectra of La, Ce, and Ho injected by TESPEL.

Experimental conditions:
\((R_{ax}, \text{Polarity}, B_t, \gamma, B_q) = (3.6 \text{ m, CW}, 2.75 \text{ T, } 1.2538, 100.0\%)\)

#170376–170409

Experiment:
The three lanthanide elements were injected into NBI plasmas with electron density around \((3–5) \times 10^{19} \text{ m}^{-3}\).

Extreme ultraviolet spectra in several different wavelength ranges were measured by multiple spectrometers.

Results:
EUV spectra including unknown lines were observed in high/low temperature cases. In particular, Ce spectra were clearly observed as shown in the figure.