(TG1) Multi-ion group report



Nov. 22, 2022 (M. Kobayashi)

Date: Nov. 18, 2022 Time: 13:25 - 18:45 Shot#: 183835 – 183935 (101 shots) Prior wall conditioning: No Divertor pump: Off Gas puff: D2, He, Ar IPD: No LID: On NBI#(1, 2, 3, 4, 5)=gas(D, D, D, D, D)=P(1.9, 2.1, 2.2, 6.2, 6.9) MW ECH(77GHz)=ant(5.5-U, 2-OUR)=P(703, 723)kW ECH(154GHz)=ant(2-OLL, 2-OUL, 2O-LR)=P(792, 799, 825) kW ECH(116GHz)=ant(2O-LR)=P(-)kW ECH(56GHz)=ant(1.5-U)=P(-)kW ICH(3.5U, 3.5L, 4.5U, 4.5L) = P(0.74, 0.71, 0.71, -) MWNeutron yield integrated over the experiment = 1.8×10^{17}

Topics

- 1. Effect of a mixed-ion plasma on impurity transport in D-NBI heated plasmas (N. Tamura)
- 2. Observation of ultra higher harmonic ICEs during He beam injection (H. Igami)
- 3. Helium removal in helium beam experiments (G. Motojima)

Mixture-induced phase transition in multi-ion transport (N. Tamura, A. Dinklage et al.)

Experimental Configuration: (R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CCW, 2.7500 T, 1.2538, 100.0%) **Shots:** #183835 – #183840, #183897 - #183912

Goal of this experiment: To study the change of the impurity accumulation window in H/D/He-mixed plasmas

- This time, TESPEL was injected to understand the change in core impurity transport Results:
- We tried to change the He contents in the plasma by using different gas puff settings around n_{e_bar} of 4e19 m⁻³ under the <u>D-dominant condition</u>: D/(H+D) ~ 1.0
- As in the case of R = 3.9 m, when He contents increased, the plasma duration was prolonged, and Bolometer signal level, Ar Li-like intensity level (introduced by gas-puff), and Ti Li-like intensity level (introduced by TESPEL) were decreased



Search for optimal conditions of He beam injection into D-NBI heated plasmas (N. Tamura on behalf of TG1)

Experimental conditions, Shots: (R_{ax}, Polarity, B_t, γ, B_q) = (3.60 m, CCW, 2.7500T, 1.2538, 100.0%), #183865 - #183896 **Goal of this experiment:** Commissioning of the He beam injection with NBI#5 into LHD plasmas Main results of this experiment

- Target line-averaged density was ~ 1E19 m⁻³, but actual line-averaged density in the session was ~ 2E19 m⁻³ (even w/o gas-puff)
- To confirm the core fueling of He by the He-NBI, we have performed
 - The experiments with He beam injection and without He beam injection (but a He gas was introduced in the NBI#5)
 ✓ We observed changes in response to different He beam operations
 - 2. The different He beam injection timing (3.73s 4.33s, and 4.13s 4.73s)
 - ✓ We observed changes in response to different He beam injection timing



Bursty RF emissions during He beam injection were observed up to GHz frequency range

Shot #: 183840 - 183864 **Experimental conditions:** (*R*_{ax}, Polarity, *B*_t, *γ*, *B*_g) = (3.6 m, CCW, 2.75 T, 1.2538, 100.0%)

Background & Purpose:

- During He beam injection discharge #169511 (22th cycle), bursty RF emissions were observed up to GHz range
- Intense large peaks appeared with interval of ~230 MHz with fine peaks of ~10/~20 MHz
- In this experiment, excitation of similar RF bursts with D/H tangential and perp. beams, different background gas, and density to investigate the characteristics of wave-wave coupling between the lower hybrid wave and ion cyclotron harmonic waves was tried.



H. Igami

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BL 1, 2, 3, 4 : H beams
BL 5 : He beam, 1.35 MW
ne ~ 1.5 x 10<sup>19</sup>m<sup>-3</sup>
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Bursty RF emissions during He beam injection were observed up to GHz frequency range

Experimental Results

- He beam of 6.3 MHz (n_e=2-3 x 10¹⁹m⁻
 ³) and 3.1 MW (ne~1.5 x 10¹⁹m⁻³) was superimposed to deuterium tangential and perpendicular beams and ECRH
- With He beam injection of 3.1 MW(n_e~1.5 x 10¹⁹m⁻³), random increment of peak intensity was observed at 200-300 MHz range.
- Intensity at ~220MHz increase after decrement of intensity at 280 MHz.
- However, the amount of the increment is very small compared to the previous observation
- The time interval of each increment is less than the previous case



H. Igami

He removal dependence on target electron density G. Motojima, N. Tamura, K. Hanada (Kyushu Univ.)

✓ #183913-183935 R=3.6m, B=-2.75T, γ =1.254, Bq=100%



- Clear difference in the decay time of He is observed with and without RMP in He beam injection phase (See the report of S. Sereda). In this study, the effectiveness of RMPs was also examined with regard to helium removal.
- \checkmark Flattening observed in the temperature profile when LID is applied.
- Emission of He releasing from PFC appears to be more pronounced when LID is applied. However, the history of He removal from shot to shot also needs to be carefully investigated at in detail.
- 6/ G. Motojima