(TC) Transport and Confinement Report

June 20, 2024 (M. Nishiura)

Date: June 19, 2024
Time: 10:20 - 16:45
Shot#: 193484 – 193610 (127 shots)

Prior wall conditioning: He GD
Divertor pump: ON
Gas puff: He, Ar, H
Pellet: No
NBI#(1, 2, 3, 4, 5)=gas(H, H, H, H, H)=P(2.8, 2.8, 3.2, 2.5, 5.4)MW

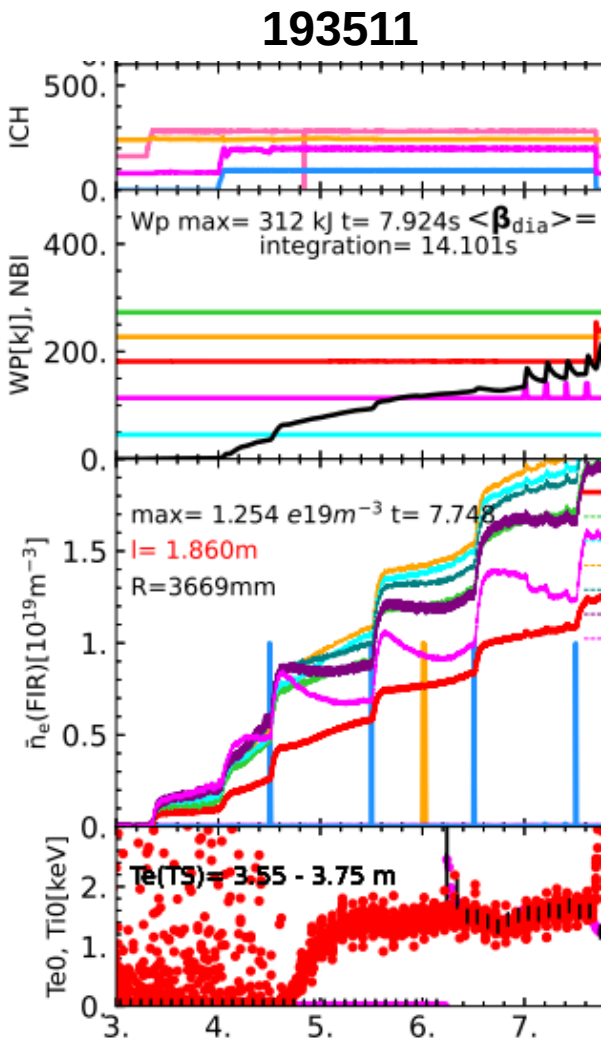
ECH(77GHz)=ant(5.5-Uout (or 1.5U), 2-OUR)=P(337, 380)kW
ECH(154GHz)=ant(2-OLL, 2-OUL , 2-OLR)=P(389, 580, 606)kW
ECH(56GHz)=ant(1.5U)=P(-)kW
ICH(3.5U, 3.5L, 4.5U, 4.5L)=P(0.4, -, 0.6, 0.6)MW

Topics

1. ICRF plasma production and heating (Y. Kovtun, T. Seki, V. Moiseenko, R. Seki, S. Masuzaki)
2. Demonstration of real-time ECH plasma control by the data assimilation system ASTI (S. Murakami, Y. Morishita, N. Kenmochi)

ICRF plasma production and heating
(Y. Kovtun, T. Seki, V. Moiseenko, R. Seki, S. Masuzaki)

Experimental conditions: (R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CW, 2.75 T, 1.254, 100.0%) Shots: #193484 - #193528



Goal of this experiment:

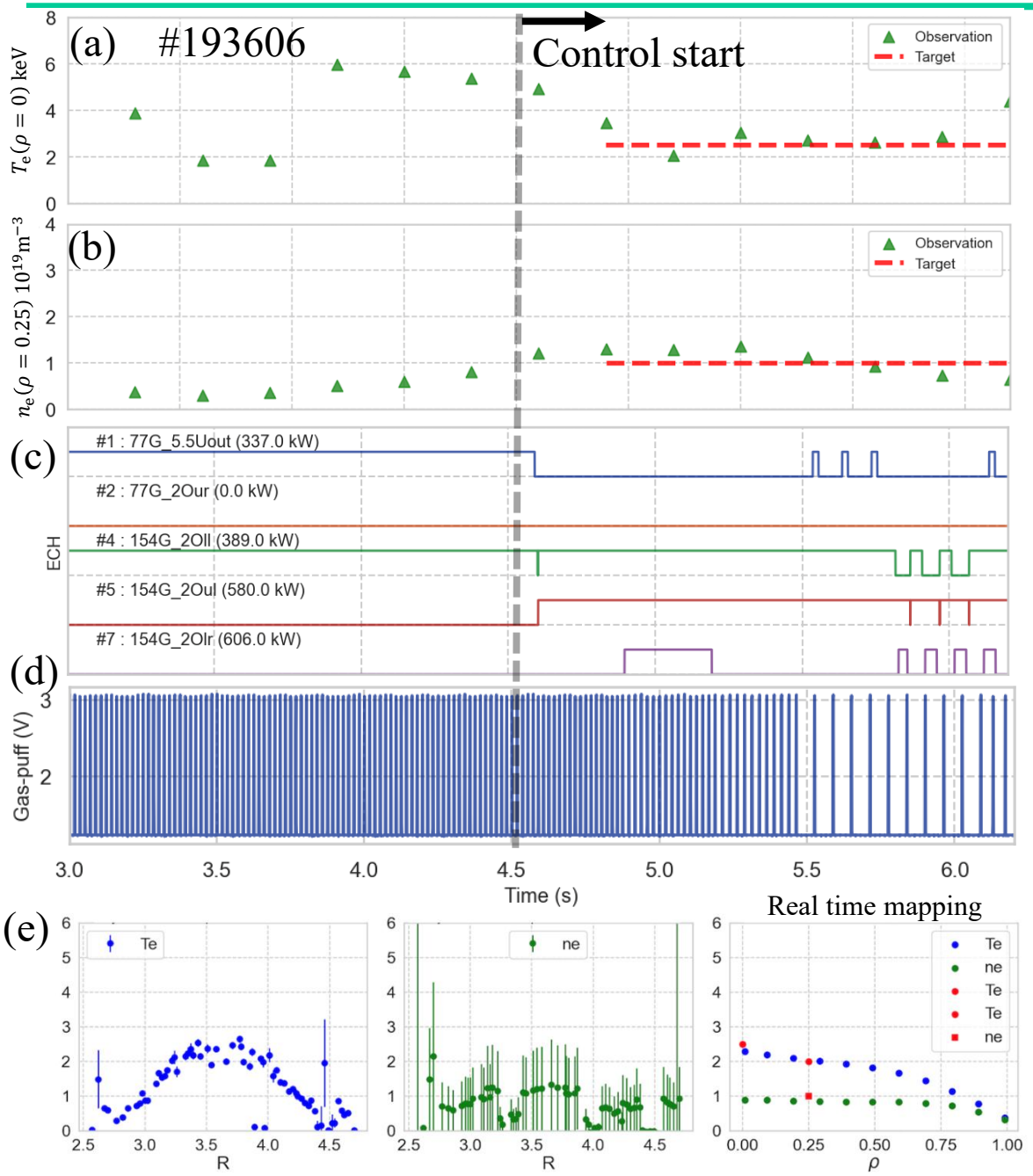
- The objective of this study is to produce a high-temperature plasma using only ICRH and to study its parameters. Measuring the temperature of electrons and ions.

Results:

- The experiments observe electron center temperatures of more than one keV and ion temperatures of more than one keV using only ICRH in He+H plasma.
- In scenarios, stable RF breakdown and plasma creation are observed.
- The plasma density is observed is up to **1.2e19 m^{-3}**.
- The electron temperature in the center is up to **2.5 keV**.
- Ion temperatures up to **2 keV**.

Measurements of the ionic temperature distribution using CXS have been performed.

Demonstration of real-time ECH plasma control by the data assimilation system ASTI (S. Murakami, Y. Morishita, N. Kenmochi)



Shot #: 193533-193610

Experimental conditions:

(R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CCW, 2.75 T, 1.254, 100 %)

Motivation and objective:

To demonstrate the electron temperature and density control by the data assimilation-based control system .

Results:

- The ECH system, gas-puff system and NB#4&5 have been successfully connected to the DA-based control system.
- We have conducted experiments to control the electron density and the radial profile of electron temperature by the gas-puff and ECH with two separate heating positions (axis & ρ=0.4) .
- The density control was achieved by adjusting the frequency of pulsed gas-puff as shown in Fig. (d).
- This system performed 6144 predictive simulations by TASK3D in parallel to compute the likelihood of each control input for the target state, while the model parameters are optimized by the observations. This computation was performed in supercomputer RAIJIN.
- The electron density and temperature obtained by the real-time Thomson scattering measurement system ware assimilated every 0.3 s.
- We have confirmed that the control system works properly and successfully produced the target temperature profile and density as shown in Fig. (e).
- Control experiments including ion temperature using NB#4a, b, and #5a were also performed. We confirmed that the predicted and observed ion temperatures in real time were close (±0.3 keV).