(TG1) Multi-ion group report

Dec. 24, 2021 (G. Motojima)

Date: Dec. 23, 2021
Time: 9:50-18:45
Shot#: 175868 – 175959 (92 shots)

Prior wall conditioning: No
Divertor pump: No
Gas puff: D2, H2, Ne
IPD: YES

NBI#(1, 2, 3, 4, 5)=gas(H, H, H, D, D)=P(0,0,0,0.5,0)MW

ECH(77GHz)=ant(5.5-U, 2-OUR)=P(0.14, 0.16)MW
ECH(154GHz)=ant(2-OLL, 2-OUL, 2O-LR)=P(0.21/0.12, 0.20/0.09, 0.34)MW
ICH(38.47MHz)=ant(3.5U, 3.5L, 4.5U, 4.5L)=P(0.49,0.49,0.75,0.41)MW
Neutron yield integrated over the experiment = 6.5×10^{14}

Topics

1. Particle control with and without divertor pumping (G. Motojima)
2. Divertor detachment study using impurity puffs (R. Lunsford (PPPL), S. Masuzaki)
3. Time evolution study of particle confinement time in temporal discharge (H. Kasahara, Y. Yoshimura)
4. Observation of gyrotron frequency and change of relative phase between forward and backward waves during power injection into the plasma (R. Yanai, Y. Oda, H. Igami)

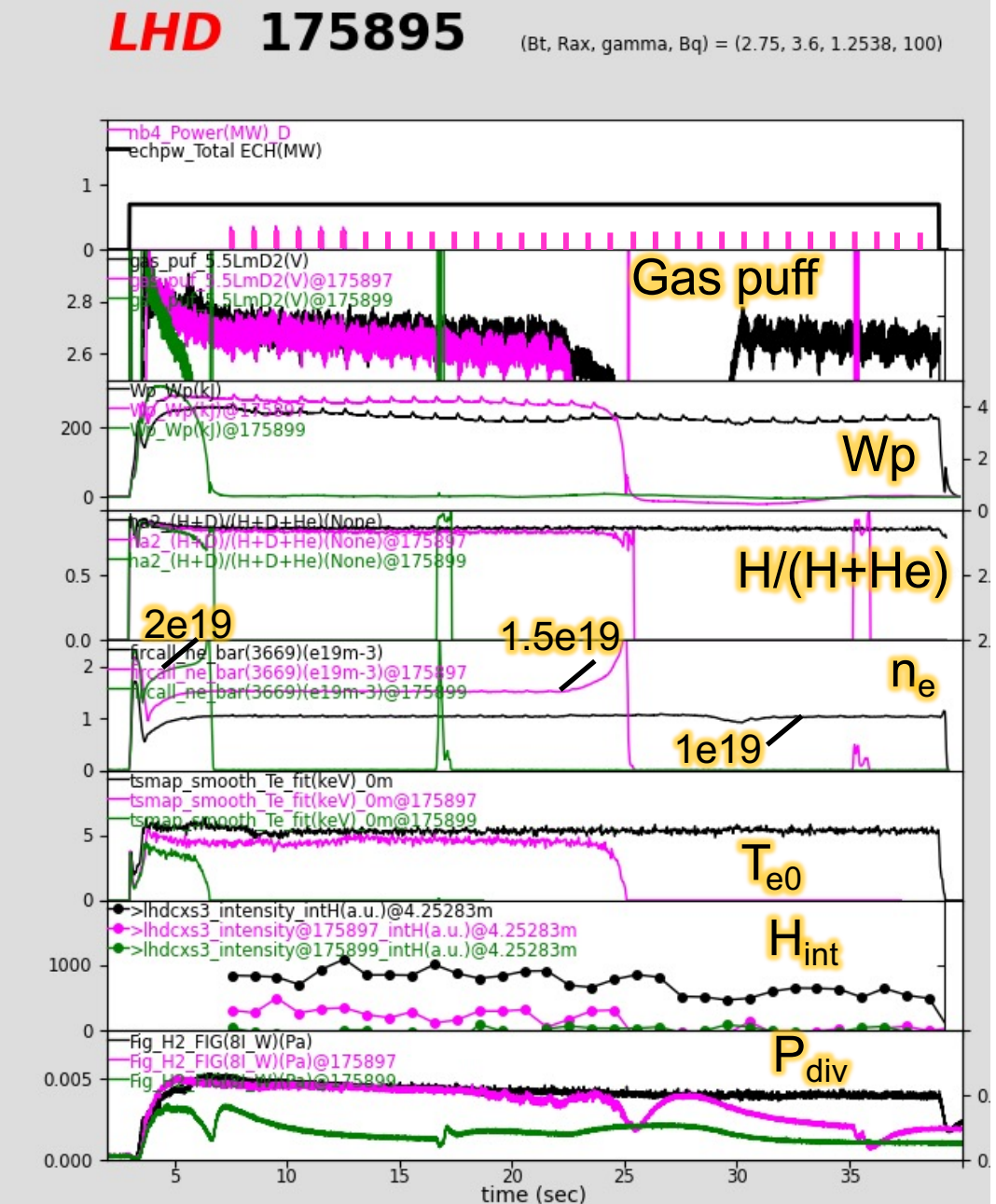
1. Particle control with and without divertor pumping (G. Motojima, S. Masuzaki)

Magnetic Configuration:
(R_{ax}, Polarity, B_t, γ, B_q) = (3.60 m, CW, 2.75 T, 1.2538, 100.0%)
Shots: 175890-175903 (14 shots)
Goal of this experiment:

- To study the effect of divertor pumping on particle control

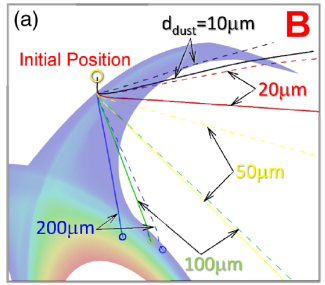
Results:

- 40 seconds ECH/ICH discharges were conducted without divertor pumping.
- NBI#4 modulation was successfully achieved in 40 second discharges to measure H profile by CXS. (thanks to NBI group)
- The target density was 1x10^{19}, 1.5x10^{19}, and 2.0x10^{19} m^{-3}
- The plasma was sustained in the case at 1x10^{19} m^{-3} by density feedback control. However, in the case with 1.5x10^{19}, and 2.0x10^{19} m^{-3}, the plasma could not be sustained in the density feedback control by gas puffing.
- The similar experiments will be performed with divertor pumping on 24/Dec. and the effect of divertor pumping will be analyzed.

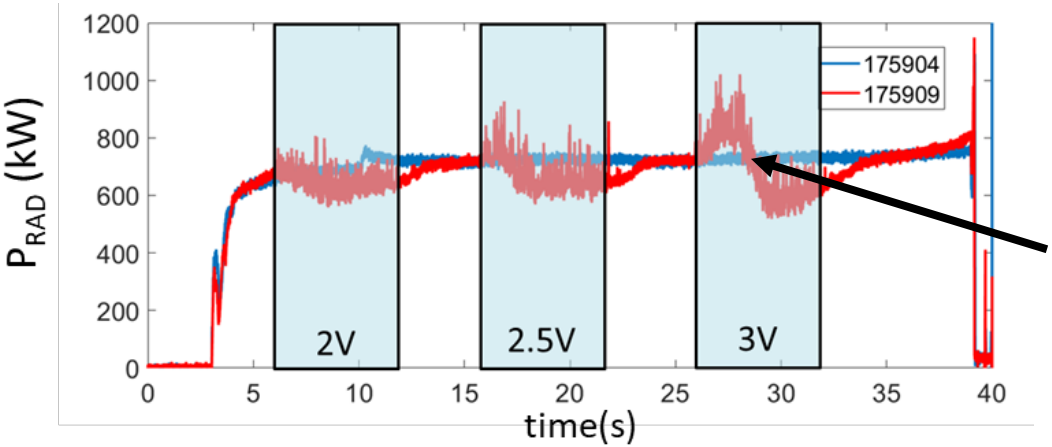


B_4C Injections into ECH & ICH heated long pulse plasmas

- 250 micron Boron Carbide granules injected from IPD to test coating buildup
  - Larger injection size chosen to provide greater penetration into confined region allowing greater toroidal distribution of entrained impurities.
  - This greater penetration made the discharge extremely sensitive to injection rate, so mass flow rate significantly smaller than pure boron or carbon injections as roughly determined by enhanced radiated power.



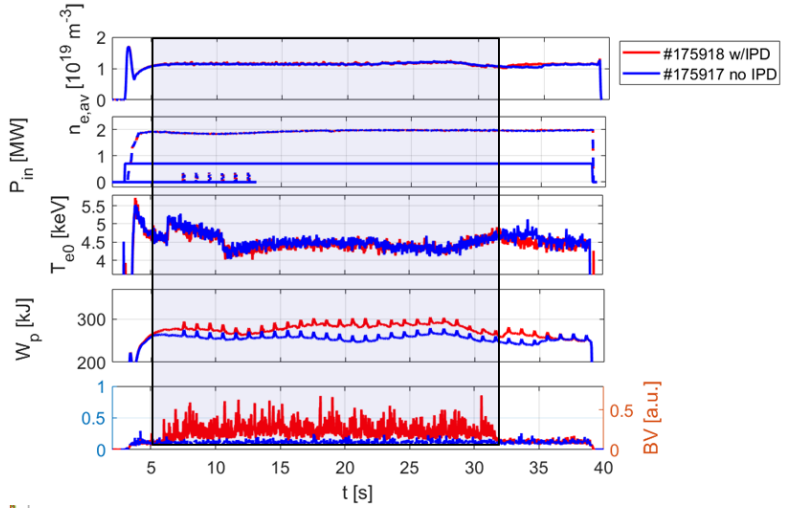
M. Shoji et al., Contrib. Plasma Phys. 60 (2020) e201900101



Gas puff turns off due to added electron burden

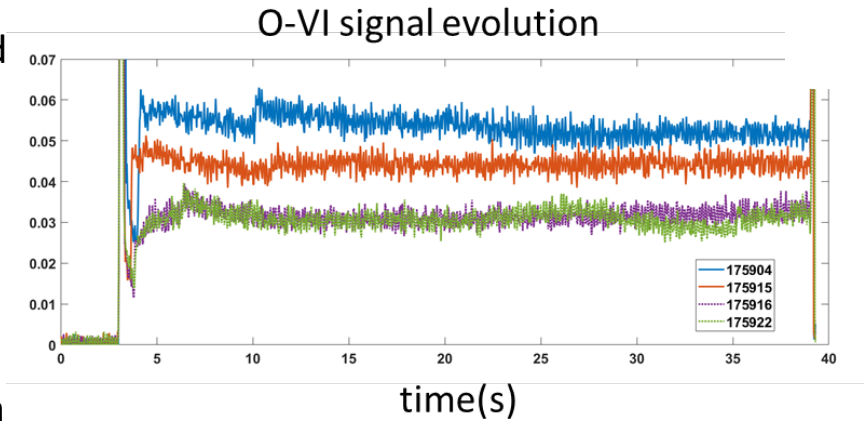
Large granules not suited for performance enhancements

- As the mass was not primarily deposited in the edge region, there are limited changes to the edge profiles
- This resulted in no enhanced temperatures and minimal enhance confinement.
- It could also be that there was not sufficient mass to affect large scale changes.

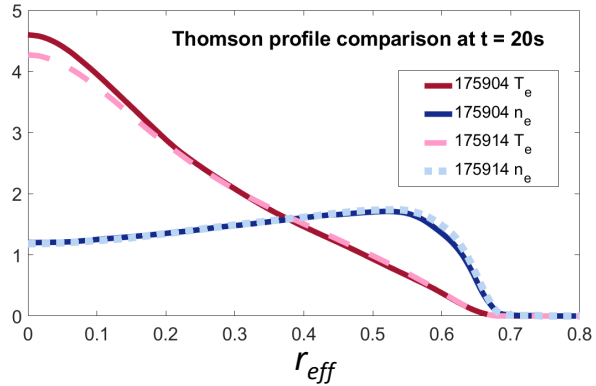


This may also explain limited conditioning effects.

Small drop in Oxygen, no change in Carbon or Iron



keV
-or-
10^{19} m^{-3}



3. Investigation of time evolution of particle confinement time and improvement of time resolution of measurement in long pulse discharge (H. Kasahara and Y. Yoshimura)

Experimental conditions: #175929 - #175959
(Polarity, R_{ax}, B_t, γ, B_q) = (CCW, 3.6 m, 2.75 T, 1.2538, 100%)
ECH Power:
77GHz#1 (5.5-Uo) = 0.139MW
77GHz#2 (2-OUR) = 0.155MW
154GHz#4 (2-OLL) = 0.205MW
154GHz#5 (2-OUL) = 0.203MW
154GHz#7 (2-OLR) = 0.343MW

ICH power:
3.5-U = 0.49MW
3.5-L = 0.49MW
4.5-U = 0.75MW
4.5-L = 0.41MW

NBI#4 for CXS measurement:
0.5s injections at every 3 min.

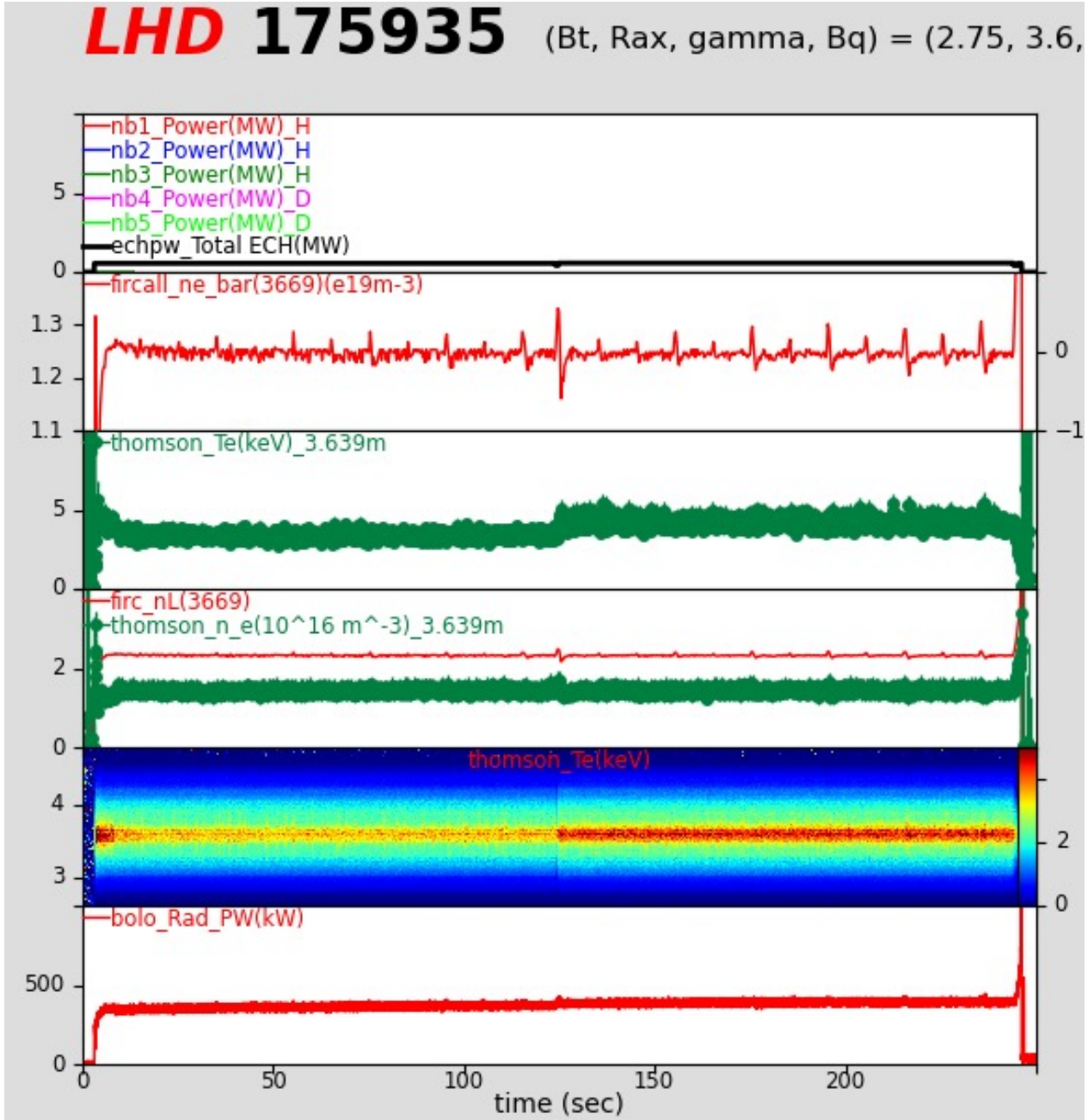
Results:
Some discharges with 390s duration, which is limited by 9m 22s sequence were achieved.

By repetitive gas-puffings of H and D during long pulse discharges, change in density response caused by the puffs was observed.

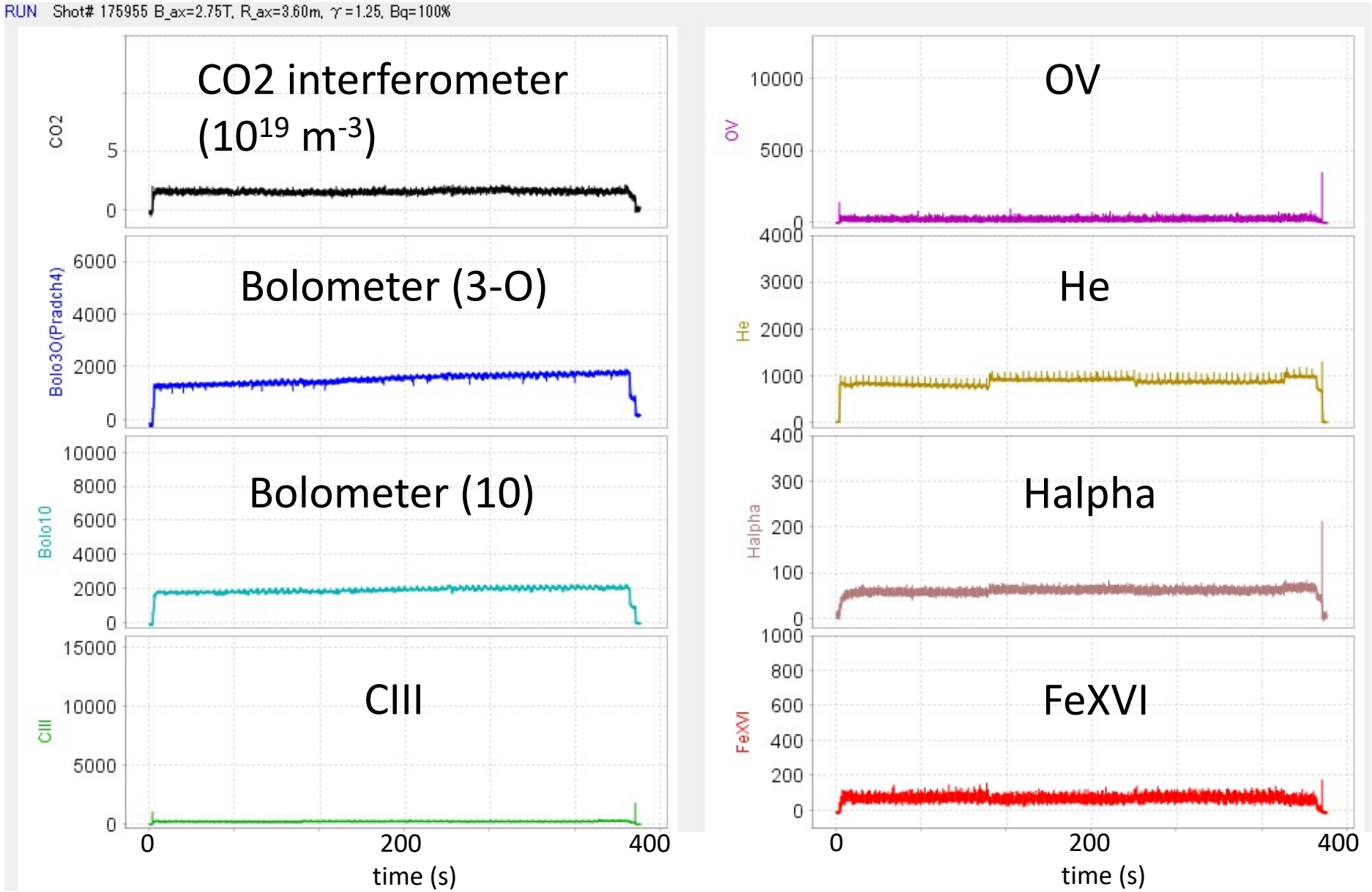
High time resolution measurement with 500kHz sampling in long pulse discharges was realized by applying PXI digitizer, for precise investigation of the cause of irregular termination. Also, event (increase in bolometer signal at termination)-triggered fast Thomson scattering measurement was performed.

Special thanks to Yokoyama-san (Tokyo Univ.) and Masahiro Kobayashi-san for their contributions to the FTS triggering

Time evolution of response of line average density against repetitive pulse gaspuffs



500kHz sampled data by using PXI digitizer (plot is thinned): CO2 interferometer, Bolometer, CIII, OV, He, Halpha, FeXVI



Observation of gyrotron frequency and change of relative phase between forward and backward waves during power injection into the plasma

R. Yanai, Y. Oda, H. Igami

Purpose:

- Investigation of the effect of the reflected wave on the gyrotron oscillation during the plasma discharge

Experimental result:

- Heterodyne detection of the gyrotron oscillation (77GHz, 2OUR) was conducted
- Frequency change and split were observed during long pulse operation
- Change of the relative phase and intensity will be investigated to examine the change of condition of the reflection at the plasma