Daily Report for 2025-12-11

C. Suzuki

Date: December 11, 2025
Time: 9:54 – 18:45
Shot: 199038 – 199204 (167 shots)
Prior wall conditioning: No
Divertor pump: No
Gas puff: H_2, He
Pellet: Fueling

NBI: #1, #2, #3, #4, #5
ECH: 5.5-UO (77GHz), 2-OUR (77GHz), 2-OLL (154GHz), 2-OUL (154GHz)
ICH: 3.5UL, 4.5UL

Topics

1. Optimization of ICRF heating scenarios to control energetic ion distribution function in phase space (Naoto Tsujii, Ryohsuke Seki)
2. Effect of HydrogenHelium Ion Composition on Sub-Alfvénic ICE via Precise Control of V_beam/V_A (Seongbin Hong, Hiroe Igami)
3. Effect of the orbit of high energy ions on the frequencies of coherent ion cyclotron and lower hybrid harmonic emissions (Hiroe Igami)
4. Study on core density peaking and flattening in plasmas (Masaki Nishiura)
5. Model predictive density profile control with pellet fueling (Christopher Anthony Orrico, Naoki Kenmochi)

Optimization of ICRF heating scenarios to control energetic ion distribution function in phase space

N. Tsujii, R. Seki, J. Wang,
T. Seki and H. Yamaguchi

Experimental conditions:

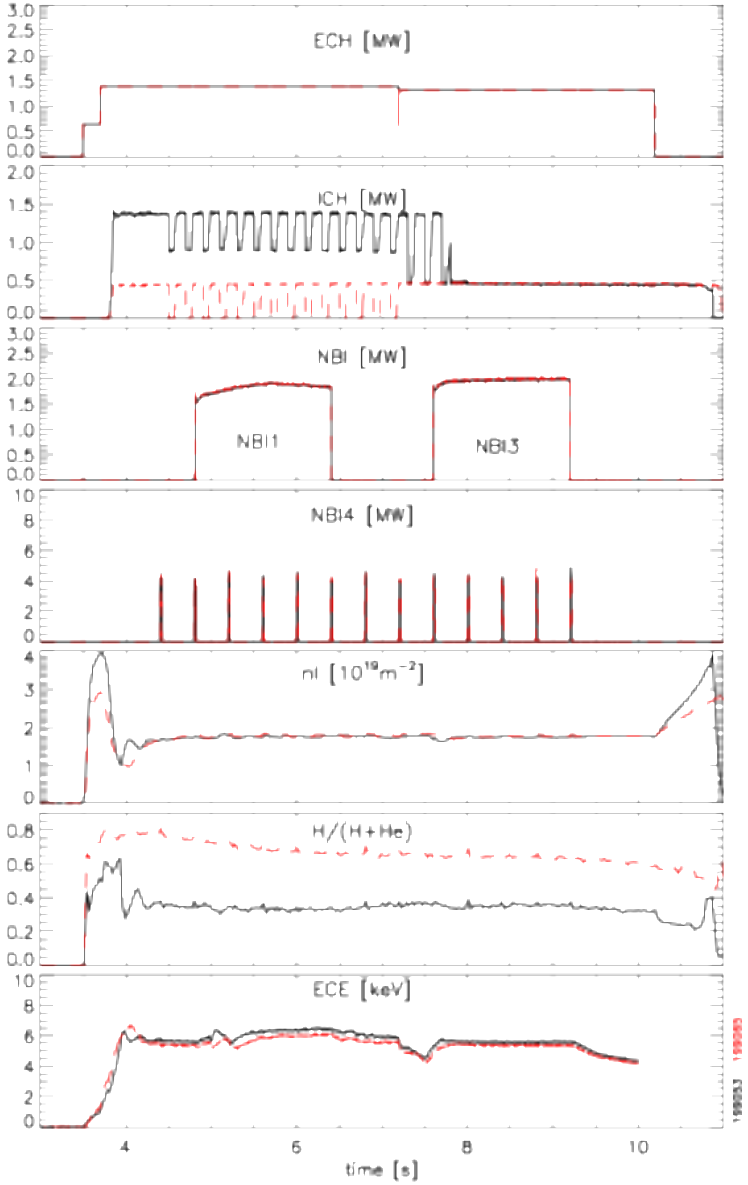
(R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CW, 2.75 T, 1.2538, 100.0%)
#199039 - #199072

Motivation and method:

- Explore ICRF+NBI heating scenario for efficient energetic ion generation
- Observe how mode conversion heating deforms bulk and beam ion distribution
- Scan the mode conversion layer with hydrogen fueling

Results:

- Obtained fast ion measurements with various combination of ICRF and NBI waveforms
- Hydrogen concentration was scanned between n_H/n_e ~ 20-50 %



Optimization of ICRF heating scenarios to control energetic ion distribution function in phase space

N. Tsujii, R. Seki, J. Wang,
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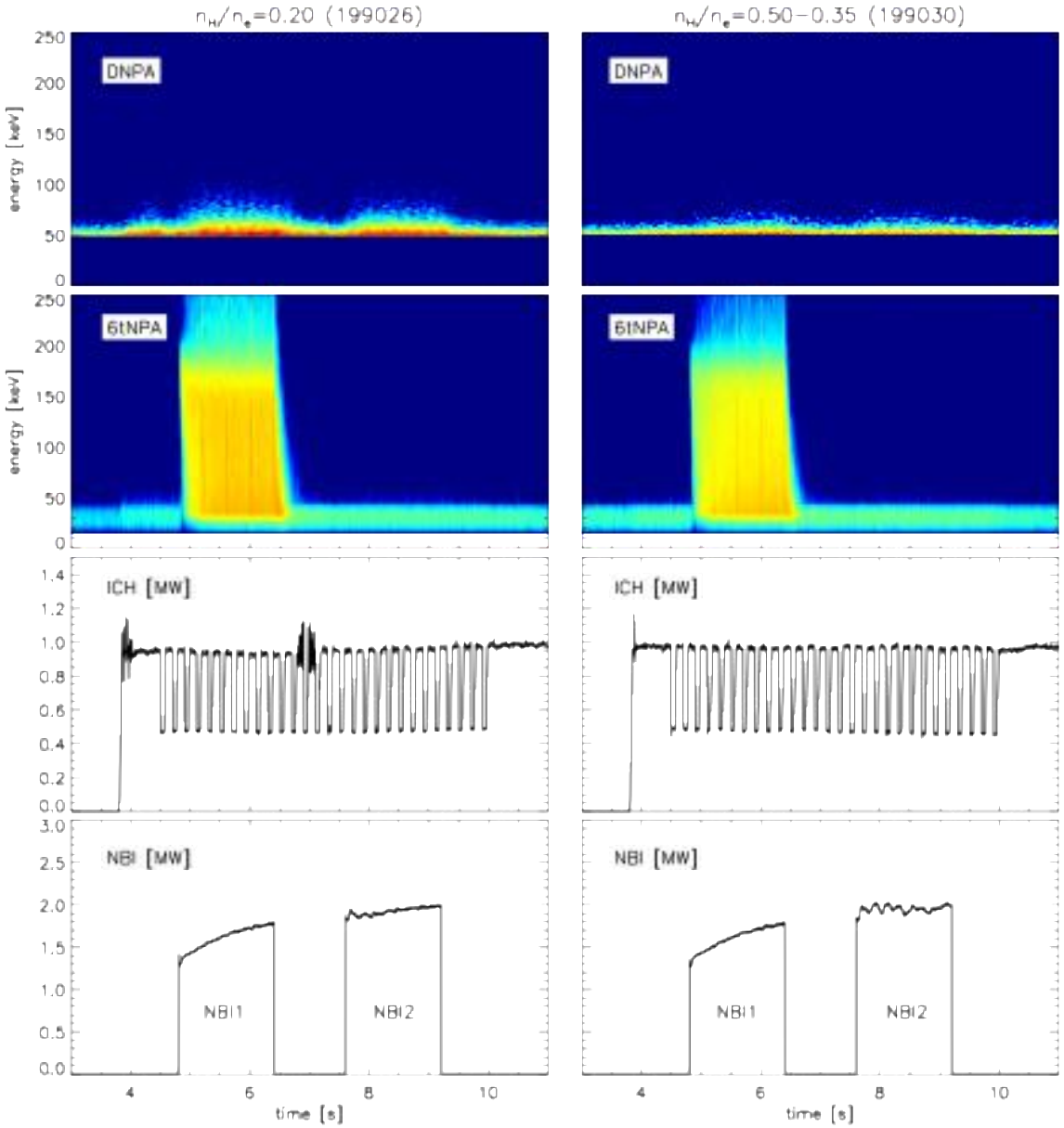


2025/12/10
result

Effect of Hydrogen-Helium Ion Composition on Sub-Alfvenic ICE via Precise Control of V_beam/V_A

S. Hong, H. Igami, G. Yun et al

Experimental conditions:

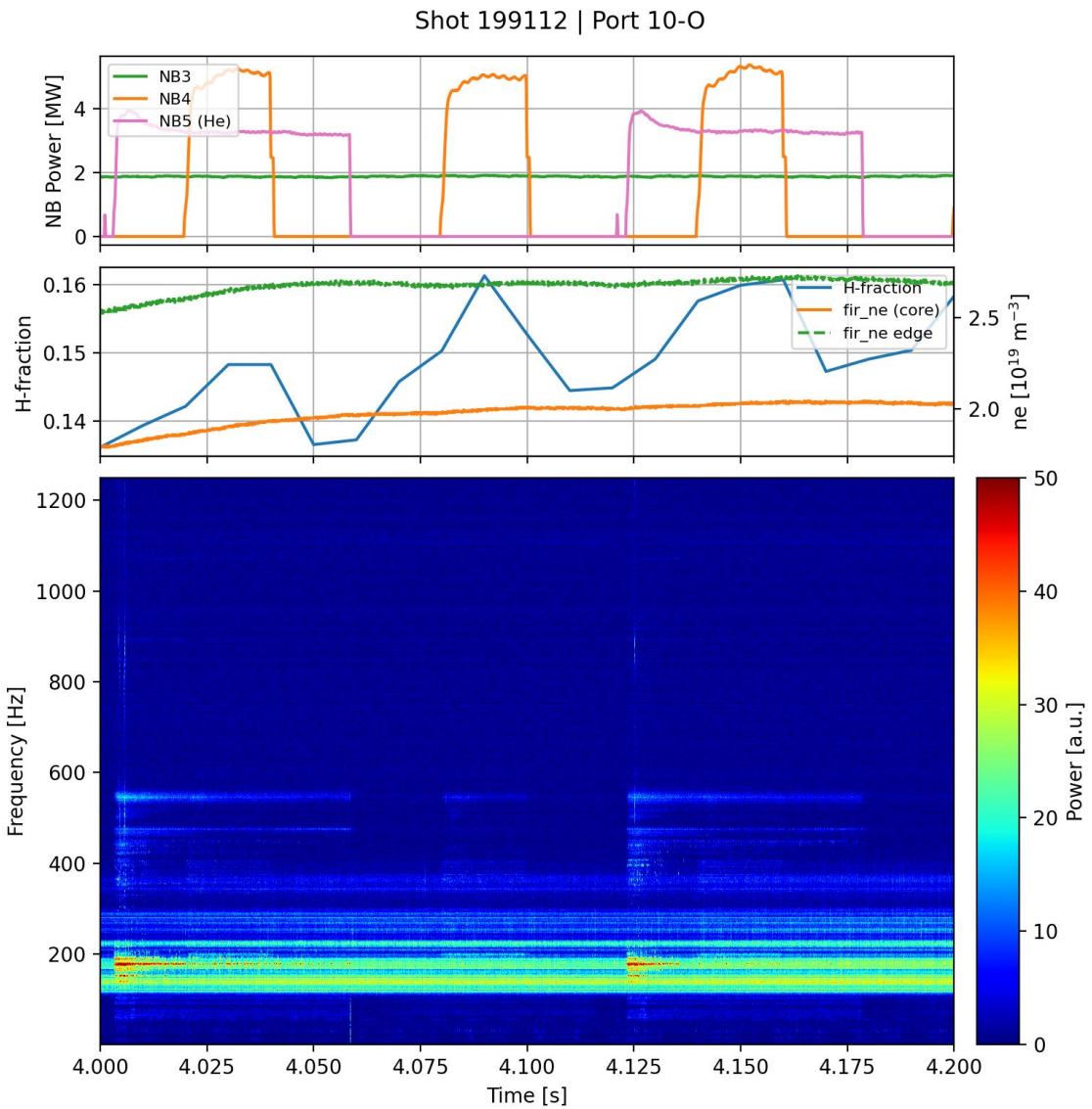
(R_{ax}, Polarity, B_t, γ, B_q) =
(3.6 m, CW, 2.75 T, 1.2538, 100.0%)
Shots : #199073 - #199142

Motivation and method:

- He NB injection can mimic α-particle during the slowing-down phase.
- We investigate fast helium diagnostics relevant burning plasma by observing He Ion Cyclotron Emission.
- By controlling the H-He composition, we aim to simulate He-rich and H-rich case
- Control parameter : BL5 energy (45, 53, 60, 65 keV)
  # of BL5 source (1, 2)
  He composition

Results:

- Unfortunately, we were not able to perform a fully H-rich case. Instead, we conducted He-rich and H:He ~5:5 cases.
- Immediately after He beam injection, ICE intensity increases sharply, indicating that ICE directly reflects the fast-ion velocity-space gradient
- Distribution of energetic particles measured by CXS, DNPA, INPA, Si-NPA will be analyzed.



Effect of the orbit of high energy ions on the frequencies of coherent ion cyclotron and lower hybrid harmonic emissions

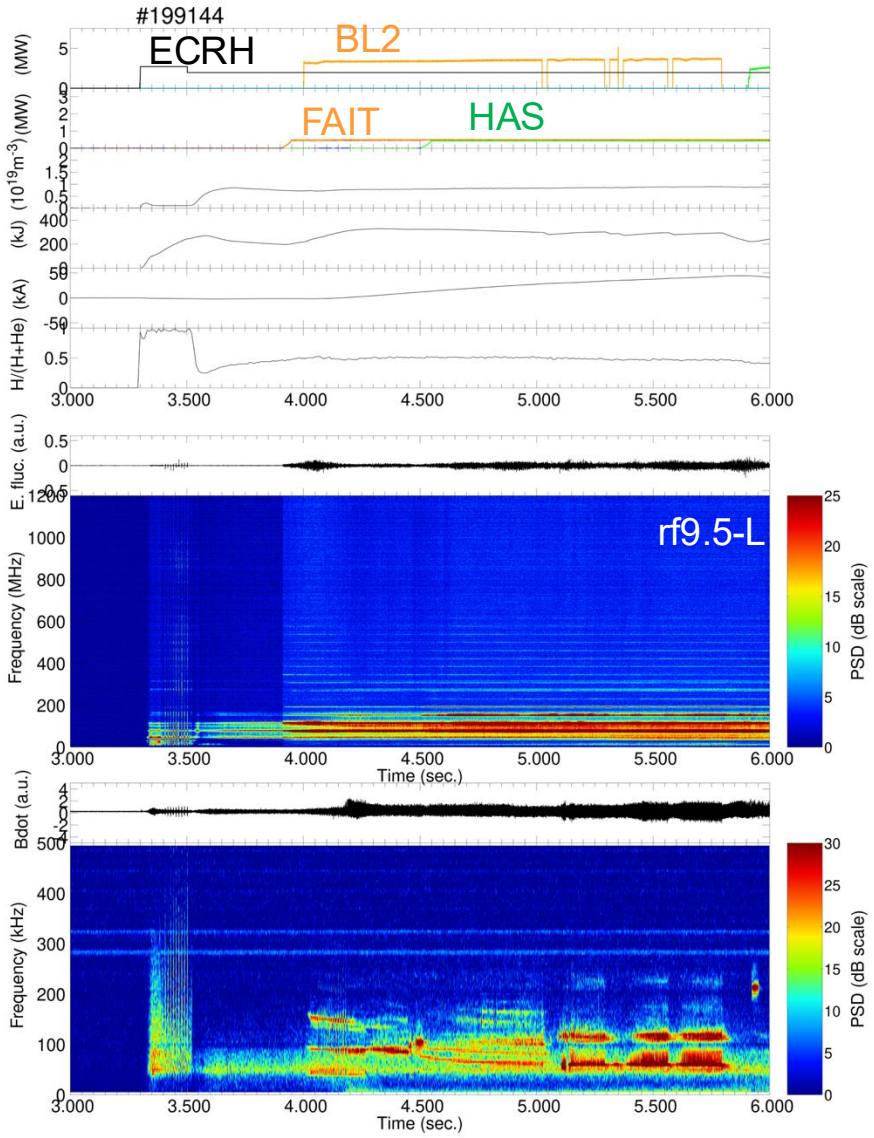
H. Igami, S. Hong, G. Yun.
T. Seki, R. Seki et al

Experimental conditions:
(R_{ax}, Polarity, B_t, γ, B_q) =
(3.60 m, CW, 2.70 T, 1.2538, 100.0%)
#199143 - #199158

Motivation and method:

- Energetic ions originated from ICRF minority heating may have varieties of the pitch angle and birth location with changing the locations of
  - Two-ion hybrid resonance
  - ICR corresponding to 38.47 MHz
- Dependence of Rf emission spectra on the magnetic configuration and heating method is investigated

Observations in discharges with mag. configurations
(R_{ax}, Polarity, B_t, γ, B_q) =
(3.55 m, CCW, 2.85 T, 1.2538, 100.0%)
(3.55 m, CCW, 2.89 T, 1.2538, 100.0%)
(3.75 m, CCW, 2.64 T, 1.2538, 100.0%)
were already conducted



Results:

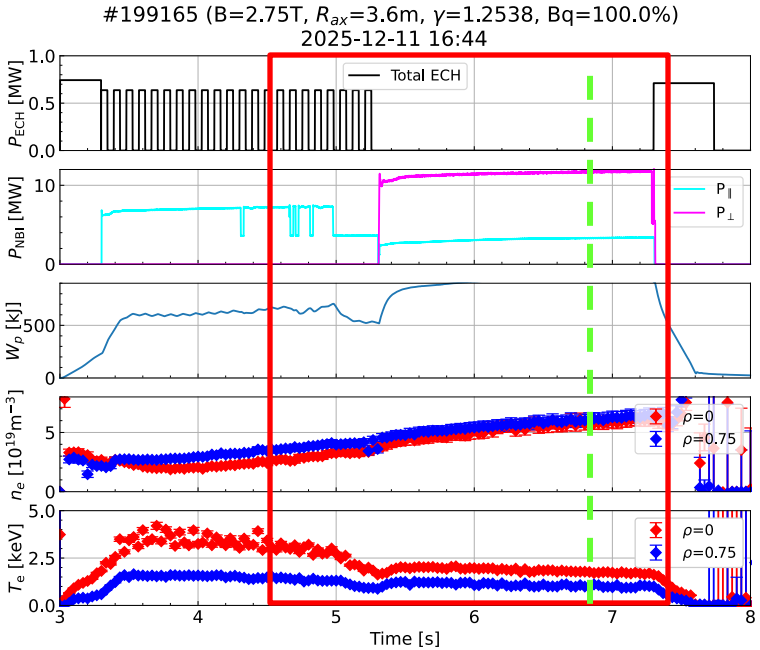
- Even during only ECRH, harmonic ion cyclotron emissions were observed
- The gap frequency of the ICE during the ECRH is different from those during ICRH
- With the occurrence of intensity and frequency changes of kHz range fluctuations, intensity and frequency of MHz range emissions also change.
- Distributions of energetic particles ratio will be analyzed
- Positions of IC, LH, two-ion hybrid resonances will be estimated to examine the location where strong nonlinear wave-wave couplings may occur

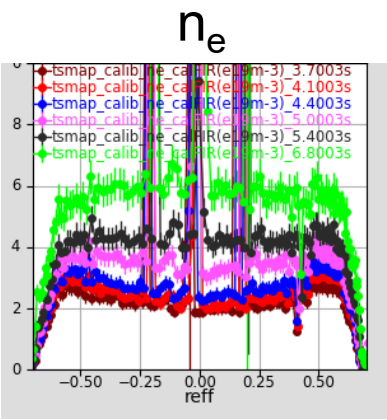
Study on core density peaking and flattening in plasmas

M. Nishiura, R. Yanai, and N. Shirokoshi

Experimental conditions:

(R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CW, 2.75 T, 1.2538, 100.0%)
#199159 - #199182, #199204





Motivation and method:

- Hollow and peaked density profiles are formed by regulated energetic ions in the LHD plasmas.
- We investigate radial particle transport driven by a helium beam, treated as a test particle to simulate conditions relevant to burning plasmas.

Results:

- The ratio $P_\perp/P_{||}$ was 4.4 with NB#4(hydrogen beam) and NB#5(helium beam). Under this condition, the electron density profile did not exhibit a hollow structure (green).
- In this preliminary report, the characteristics of the radial particle flux driven by the helium beam show differences compared with those driven by hydrogen and its isotope.

Piggy-back experiments

- V. Murugesan (MPG-IPP),"ECRH power deposition studies using calibrated ECE at LHD“
- N. Shirokoshi (Univ. Tokyo), “Validation of ECH raytrace code of Ti measurements” (December 9)
- R. Yanai, “Confirmation of alignment and polarization for 77 GHz ECH#2”

Development of model predictive density profile control with pellets and gas

C. Orrico

Experimental conditions:

(R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CCW, 2.75 T, 1.2538, 100.0%)
#199186 - #199203

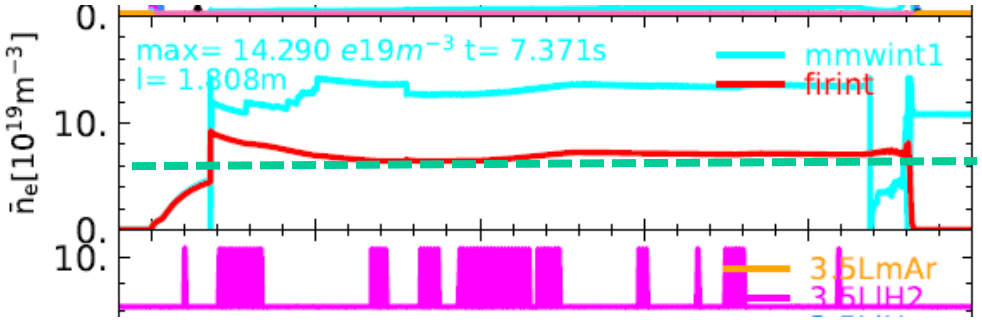
Motivation and method:

- Demonstration of model predictive density profile control using feedback of gas injection and feedforward optimization of pellet timings
- Track 3 references profiles:
  $\bar{n}_e^{low} \approx 6.5 \times 10^{19}\ \mathrm{m}^{-3}$, $\bar{n}_e^{mid} \approx 10 \times 10^{19}\ \mathrm{m}^{-3}$, $\bar{n}_e^{high} \approx 13 \times 10^{19}\ \mathrm{m}^{-3}$

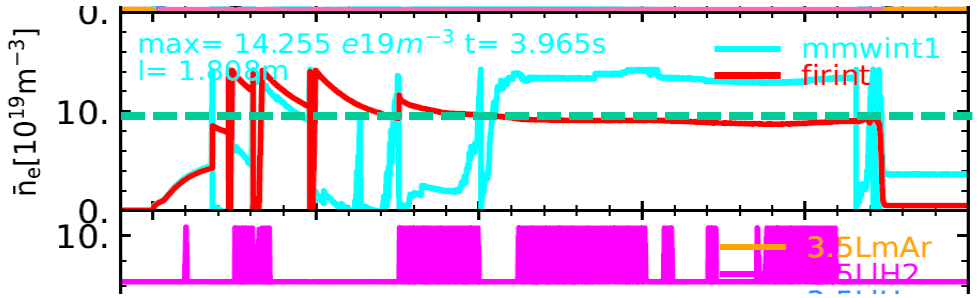
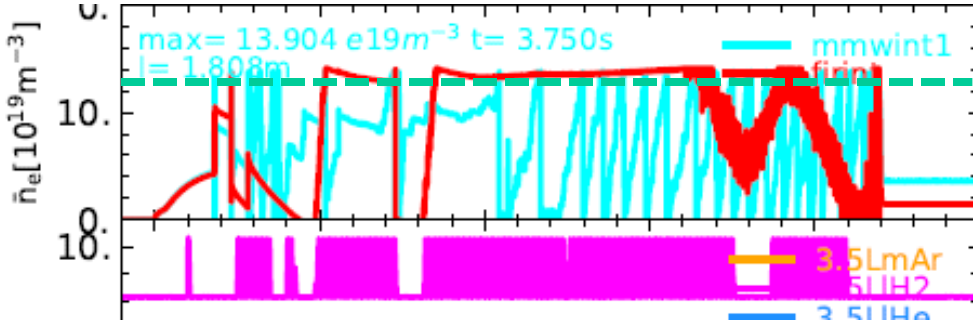
Results:

- Successfully tracked all 3 references despite pellet uncertainty (lines in red).
- TS confirms desired density profiles were achieved (cannot see here in red due to fringe jumps)
- Missed pellets represent disturbances that the online MPC controller corrects with gas (see low, mid)

199200 (ref_low)



199193 (ref_mid)



199194 (ref_high)