Daily Report for 2025-10-24

H. Igami

Date: October 24, 2025
Time: 10:00 – 17:15
Shot: 198244 – 198378
Prior wall conditioning: None
Divertor pump: Off
Gas puff: H2, He
Pellet: No

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

Topics

1. Study of core impurity transport in LHD plasmas with Rax = 3.53 m configuration (N. Tamura)
2. Nonlinear Dynamic Validation of Heat Transport Models in Fusion Plasmas through Advanced Perturbative Heating Experiments (L. Ceelen)
3. Exploration of thermal ICE in H and He (D. Moseev)
4. ICRF plasma production and heating in the hydrogen minority regime (Y. Kovtun)
5. Scenarios of plasma start⊠up at second harmonic ICRF (Y. Kovtun)

Study of core impurity transport in LHD plasmas with Rax = 3.53 m and Rax = 3.9 m

(N. Tamura(IPP), K. Mukai, K. McCarthy (Ciemat), C. Suzuki, H. Funaba)

Magnetic configuration: (R_{ax}, Polarity, B_t, γ, B_q) = (3.53 m, CW, 2.804 T, 1.2538, 100.0%)
Shots: #198246 - #198308 (63 shots)

Goal of this experiment

- The impurity transport in core LHD plasmas has been investigated using a Tracer-Encapsulated Solid Pellet (TESPEL).
- Missing data should be acquired to finalize the documentation of impurity transport in the core LHD plasmas

Approach & Methodlogy

- We performed the experiments with the magnetic configuration of Rax = 3.53 m
  - ✓ Unfortunately, due to the limited availabitliy of NBI, we gave up the experiment with Rax = 3.9 m, and conducted the experiment only with Rax = 3.53 m
- The following topics are being investigated
  - ✓ **Density profile (peaked/flat) dependence of impurity transport**
    Fe-TESPELs(large or small amount) are injected
  - ✓ **Impurity transport in EC-heated plasmas**
    Ti-, Mo-TESPELs (small amount) are injected
  - ✓ **Impurity transport in NBI-heated plasmas**
    Ti-, Mo-TESPELs (small amount) are injected

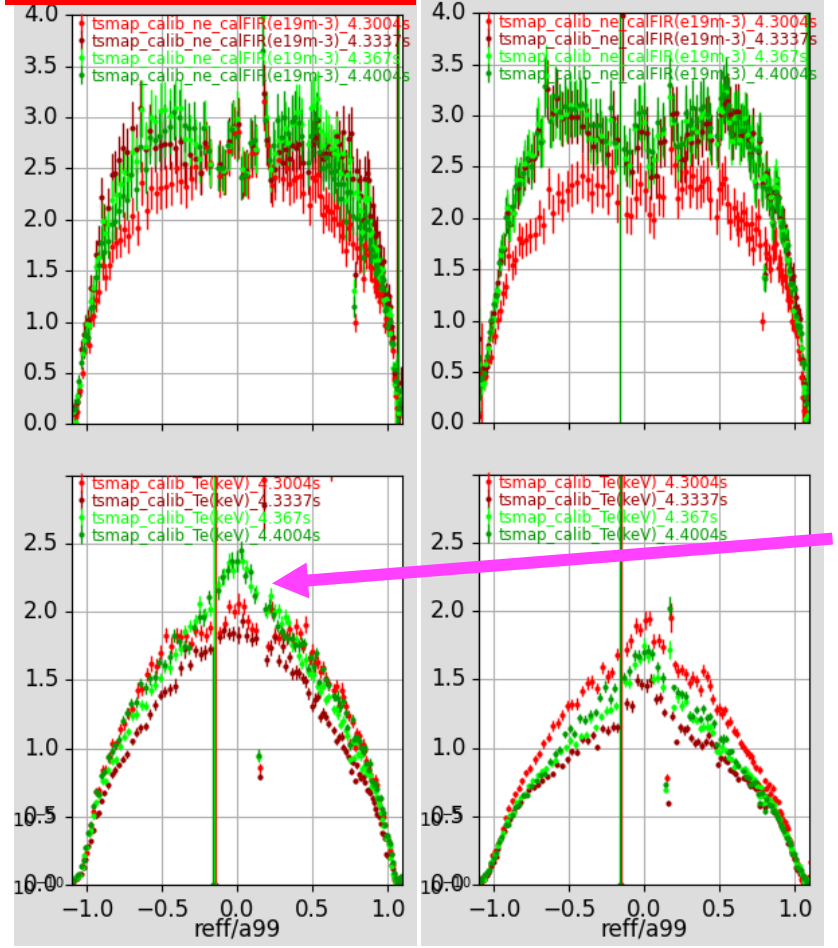
Study of core impurity transport in LHD plasmas with Rax = 3.53 m and Rax = 3.9 m

(N. Tamura(IPP), K. Mukai, K. McCarthy (Ciemat), C. Suzuki, H. Funaba)

Results: Density profile (peaked/flat) dependence of impurity transport

- It seems that impurity transport may differ depending on the profile shape

EC#4 + NB(#4 +#5) | **EC#4 + NB#4**



Note: ne_bar & Te0 are the same in both case

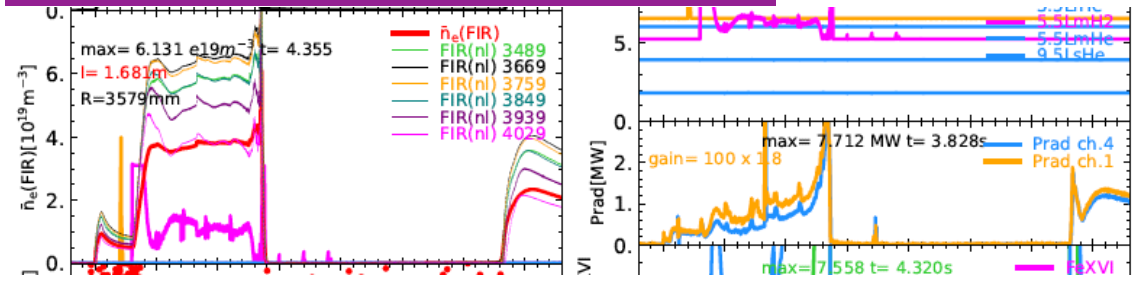
Impurity accumulation occurs in the narrow profile (right)?

Interestingly, the central Te increased

Results: Impurity transport in EC-heated plasmas

- The line-averaged density was scanned from ~1e19 upto ~4e19
- The plasma with ne_bar = 4e19, heated with EC#1, 2, 4, was collapsed after the TESPEL injection → impuritry accumulation

LHD #198279, Ti-TESPEL@3.825 s



Results: Impurity transport in balanced NBI(#2+#3)-heated plasmas

- The line-averaged density was scanned from ~2e19 upto ~6e19
- Even with ne_bar = ~6e19, the plasma was **NOT** collapsed after the TESPEL injection

The results obtained here will be compared with those with Rax = 3.6 m

Frequency intermodulation of ECH to determine nonlinear transport dynamics

H. Igami, M.P. de Beij, M.G. Hoven

Experimental conditions:

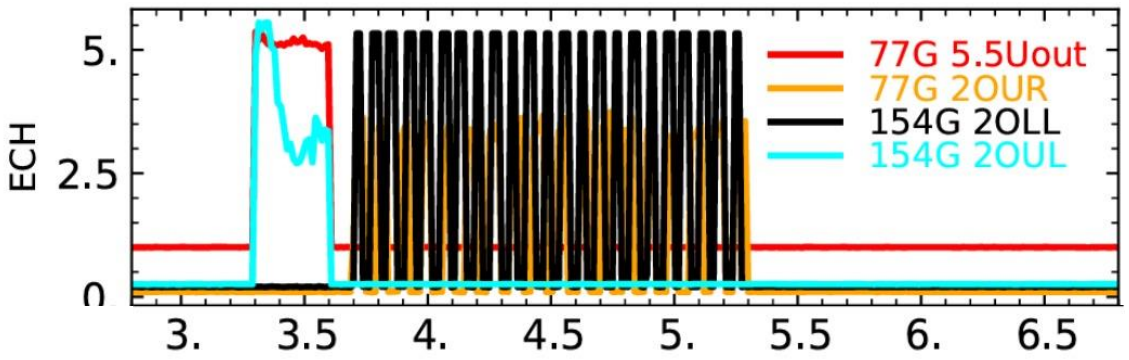
(R_{ax}, Polarity, B_t, γ, B_q) = (3.6. m, CW, 2.75 T, 1.2538, 100.0%)
#198309 – #19325

Motivation and method:

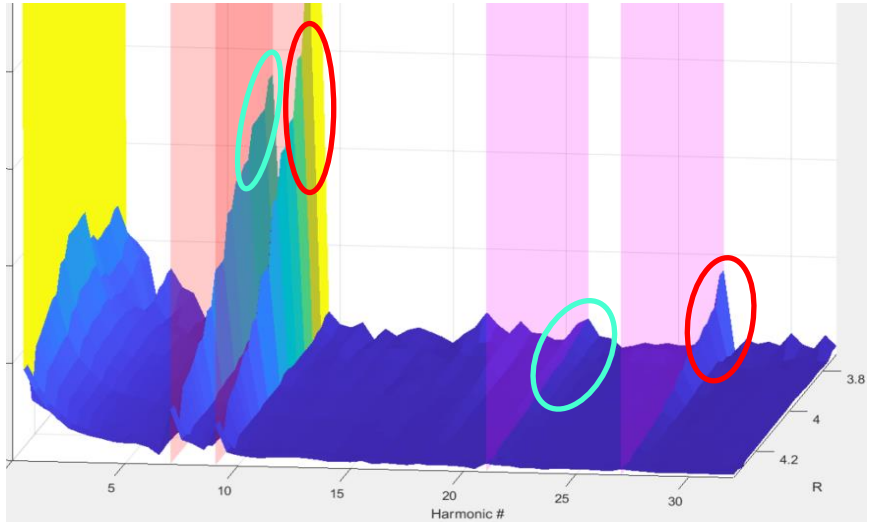
- In the frequency domain, nonlinear dynamics can be captured by intermodulation frequencies.
- Modulation of ECH at two specific frequencies

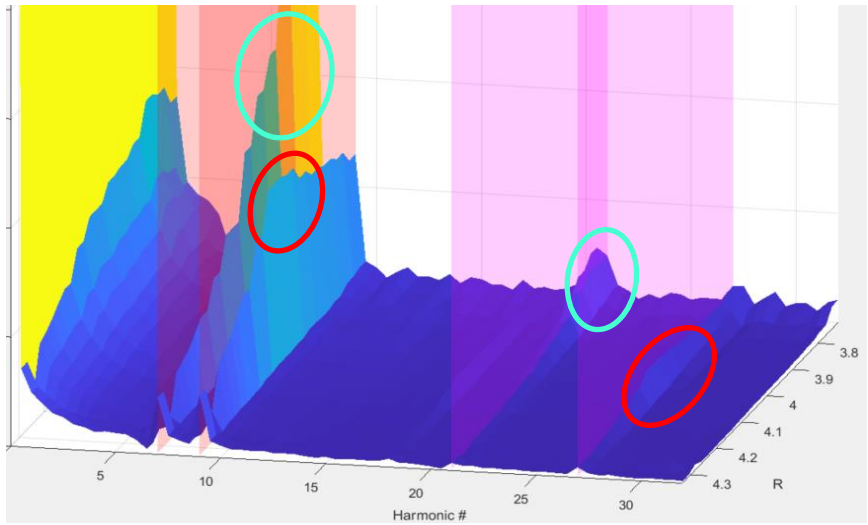
Results:

- Varying frequencies deposition location and density
- Looking at f1-f2, f1+f2, 2*fx & 3*fx



Fast Fourier Transform of ECE signal





Generation of thermal population ICE in LHD

D. Moseev

Experimental conditions:

(R_{ax}, Polarity, B_t, γ, B_q) = (3.6. m, CCW, 2.75 T, 1.2538, 100.0%)
#198326 – #198329

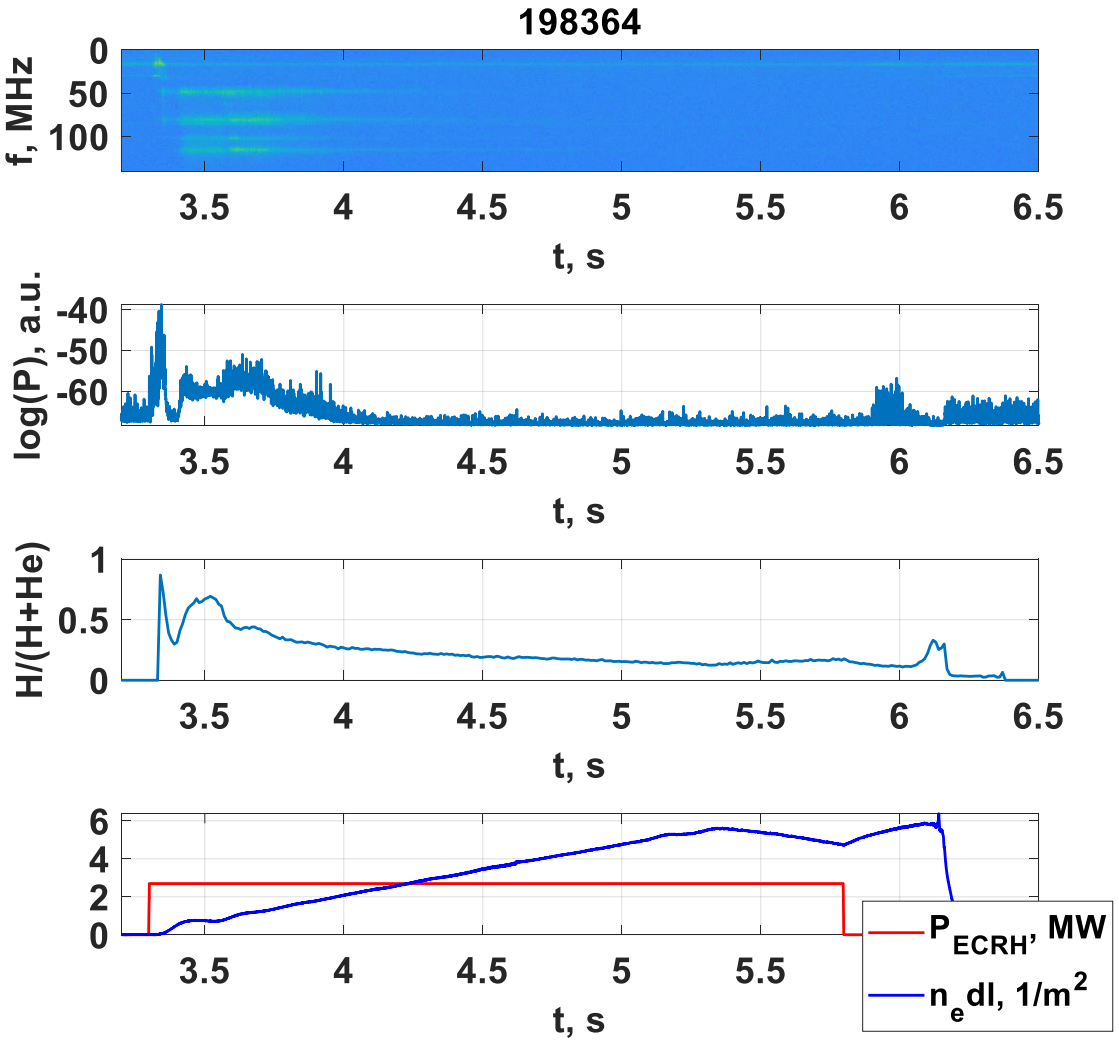
(R_{ax}, Polarity, B_t, γ, B_q) = (3.55. m, CCW, 2.789 T, 1.2538, 100.0%)
#198363 – #198368

Motivation and method:

- Are W7-X results reproducible?
- Changed dipole antennae set-up by Igami-san, no HPF but a notch filter instead
- LHD shots in two configurations, no NBI

Results:

- Thermal ICE is seen in both configuration.
- Since both density and H/He ratio changed, no clear effect on the ratio.
- Max signal at ne = 0.7 – 0.8*10^{19} m^{-3}.
- Results of W7-X are partly confirmed: thermal ICE is there, but mainly at higher harmonics (possible effect of notch?)
- Kolesnichenko's theory not applicable



ICRF plasma production and heating in the hydrogen minority regime (Y. Kovtun, T. Seki, R. Seki, S. Masuzaki, V. Moiseenko, S. Kamio)

Experimental conditions: (R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CW, 2.75 T, 1.254, 100.0%) Shots: #198333 - #198362 (30 shots)

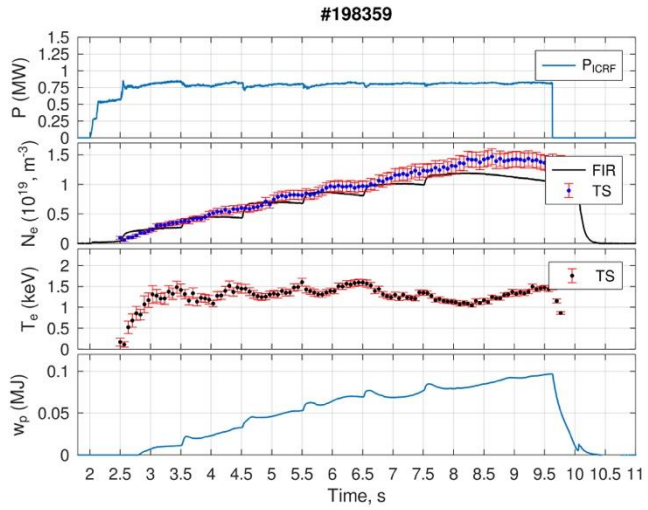
Goal of this experiment:

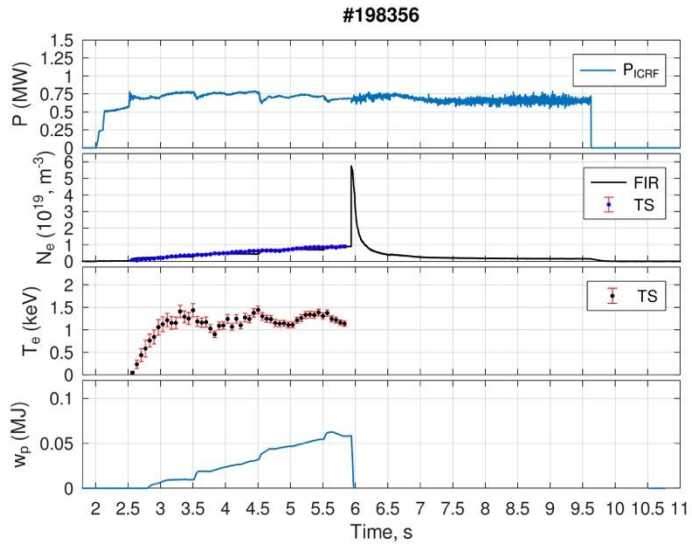
- The main objective of the proposed study is to obtain high-temperature plasma using only ICRF and to study the physical properties of plasma production and heating.

Results:

- The experiments observe electron center temperatures of more than one keV using only ICRF (RF power up to 0.8 MW) in He+H plasma.
- In scenarios, stable RF breakdown and plasma creation are observed.
- The plasma density is observed is up to **$1.5\ 10^{19}\ m^{-3}$**.
- The electron temperature in the center is up to **1.5 keV**.

First, an injection was made into the ICRF plasma. An increase in density to **$5.7\ 10^{19}\ m^{-3}$** is observed, and a further decrease in temperature and density.





Scenarios of plasma start-up at second harmonic ICRF
(Y. Kovtun, T. Seki, R. Seki, S. Masuzaki, V. Moiseenko, S. Kamio)

Experimental conditions: (R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CW, 1.375 T, 1.254, 100.0%) Shots: #198369 - #198378 (9 shots)

Goal of this experiment:

- The main objective of the proposed study is to obtain high-temperature plasma using only ICRF and to study the physical properties of plasma production and heating at second harmonic ICRF.

Results:

The first experiments on ICRF producing plasma on the second harmonic were conducted in He+H.

- In scenarios, stable RF breakdown and plasma creation are observed.
- The plasma density is observed is up to **2.5e18 m^{-3}**.
- The temperature of the electrons was low.