

# (IA) Instability & Anisotropy Session report



May 15, 2024 (Y. Takemura)

Date: May 15, 2024

Time: 10:30 - 16:45

Shot#: 191169-191270 (102 shots)

Prior wall conditioning: None, Divertor pump: Off

Gas puff: H<sub>2</sub>, Pellet: H<sub>2</sub>

NBI#(1, 2, 3, 4, 5)=gas(H, H, H, H, H)=P(4.8, 4.0, 4.0, 3.3, 3.2)MW

ECH(56GHz)=ant(1.5-U)=P(-)MW

ECH(77GHz)=ant(5.5-U, 2-OUR)=P(0.698, 0.380)MW

ECH(116GHz)=P(0.555)MW

ECH(154GHz)=ant(2-OLL, 2-OUL, 2O-LR)=P(-, -, -)MW

ICH(3.5U, 3.5L, 4.5U, 4.5L) = P(-, -, -, -)MW

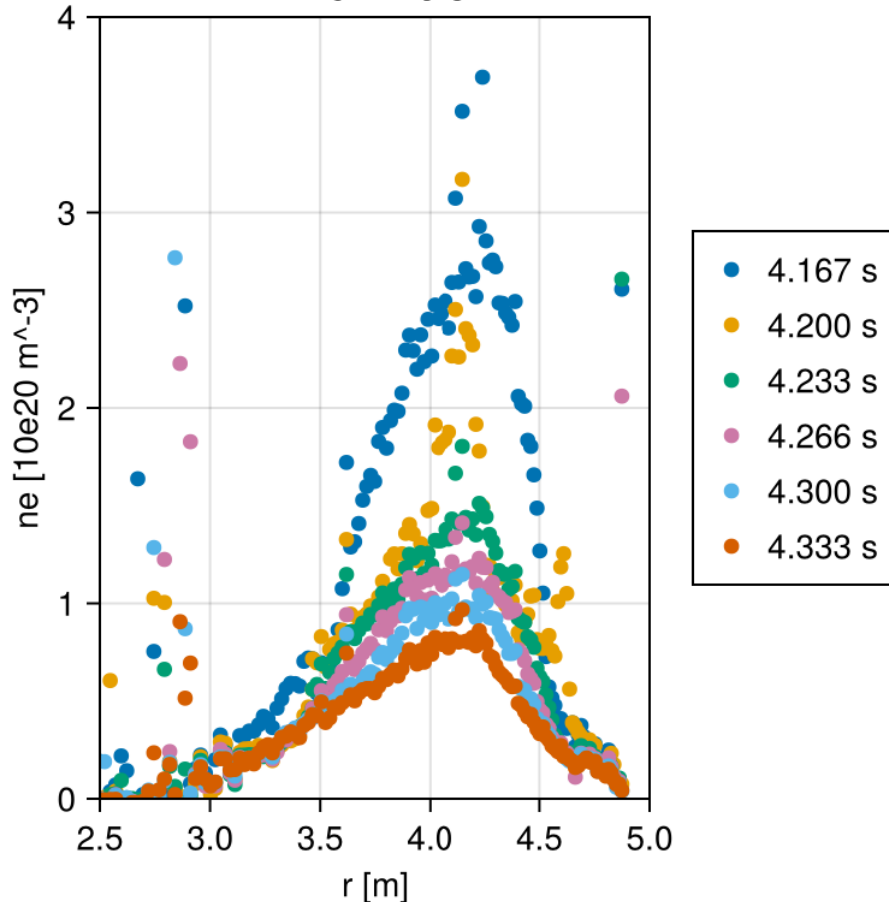
## Topics

1. Measurement of Plasma Dynamics during Core Density Collapse (CDC) in LHD (D. Den Hartog, A. Wright(UW-Madison))
2. CDC dynamics and rotational transform (H. Thomsen(IPP), Y. Suzuki, M. Yoshinuma, Y. Takemura)

# Measurement of Plasma Dynamics during Core Density Collapse (CDC) in LHD

(D. Den Hartog, A. Wright)

Density profile evolution  
#191258



## Experimental conditions:

$(R_{\text{ax}}, \text{Polarity}, B_t, \gamma, B_q) = (3.85 \text{ m}, \text{CCW}, 2 \text{ T}, 1.254, 100.0\%)$   
(#191169 - #191270)

## Objective:

Use Fast Thomson Diagnostic to measure temporally- and spatially-resolved (20 kHz over 5 ms measurement window) plasma dynamics during core density collapse events. Expected result is improved understanding of the CDC physics mechanism.

## Results:

- ✓ CDCs reliably produced with injection of 8 pellets (collapse at  $\sim 4.6 \text{ s}$ ).
- ✓ Timing of FTS was fixed at 4.199819 s meaning that it was triggered before CDC in all cases. Will be analyzed to investigate precursor activity.
- ✓ Pellet injection system malfunction, reduced to 4 pellets.
- ✓ Decrease magnetic field to 1.2 T keeping  $R_{\text{ax}}=3.85$ .  
Reliably produced CDC events with 4 pellets ( $\sim 4.19$ - $4.2 \text{ s}$ ).
- ✓ #191258 (left and next page) promising for FTS.



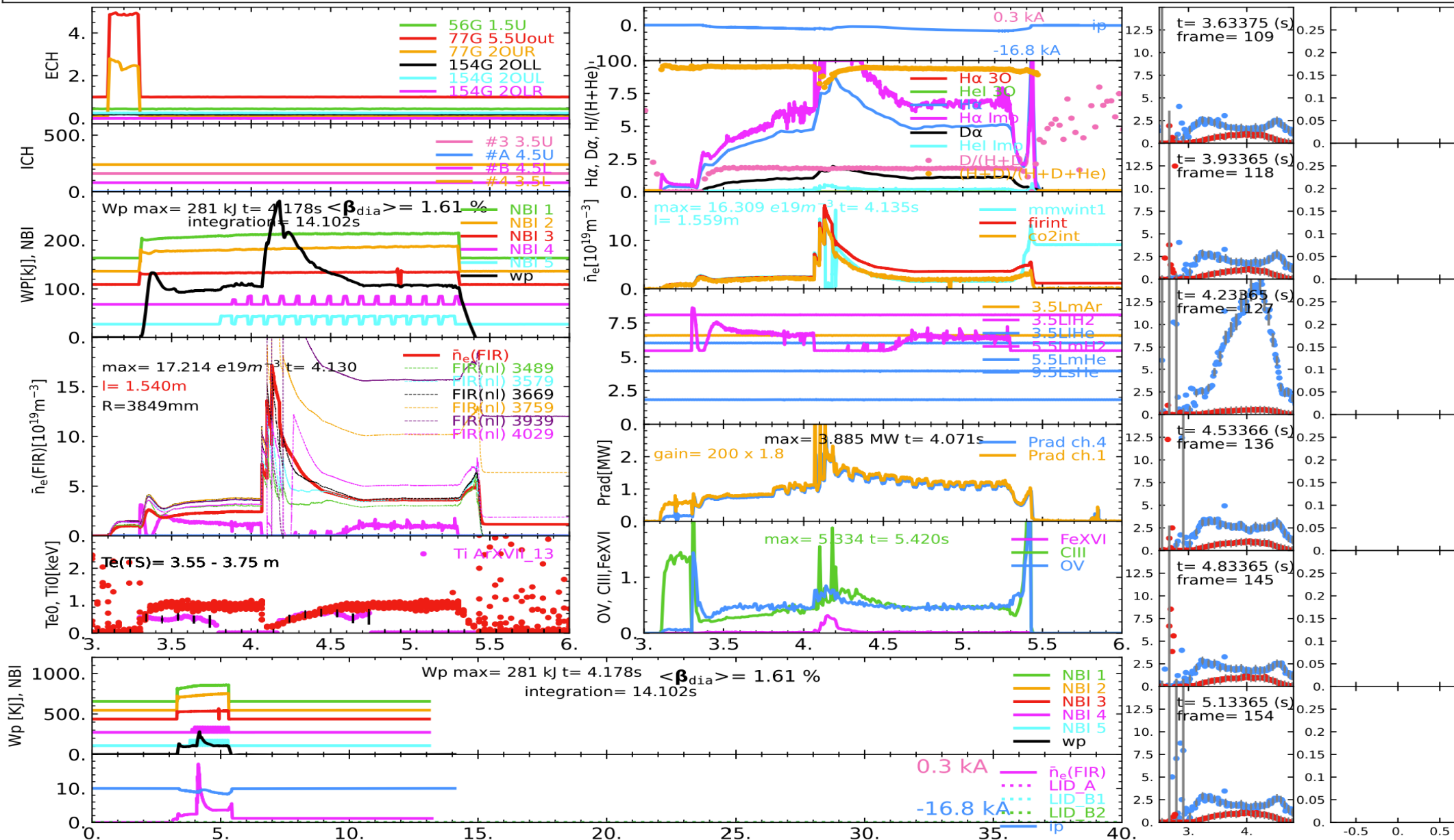
191258

 $B = -1.200\text{ T}$   $R_{ax} = 3.850\text{ m}$   $\gamma = 1.254$   $Bq = 100$ 

SEQ:3min

2024-05-15 16:07:22

Boronization, HGDC, Div.Cryo:OFF



# CDC dynamics and rotational transform

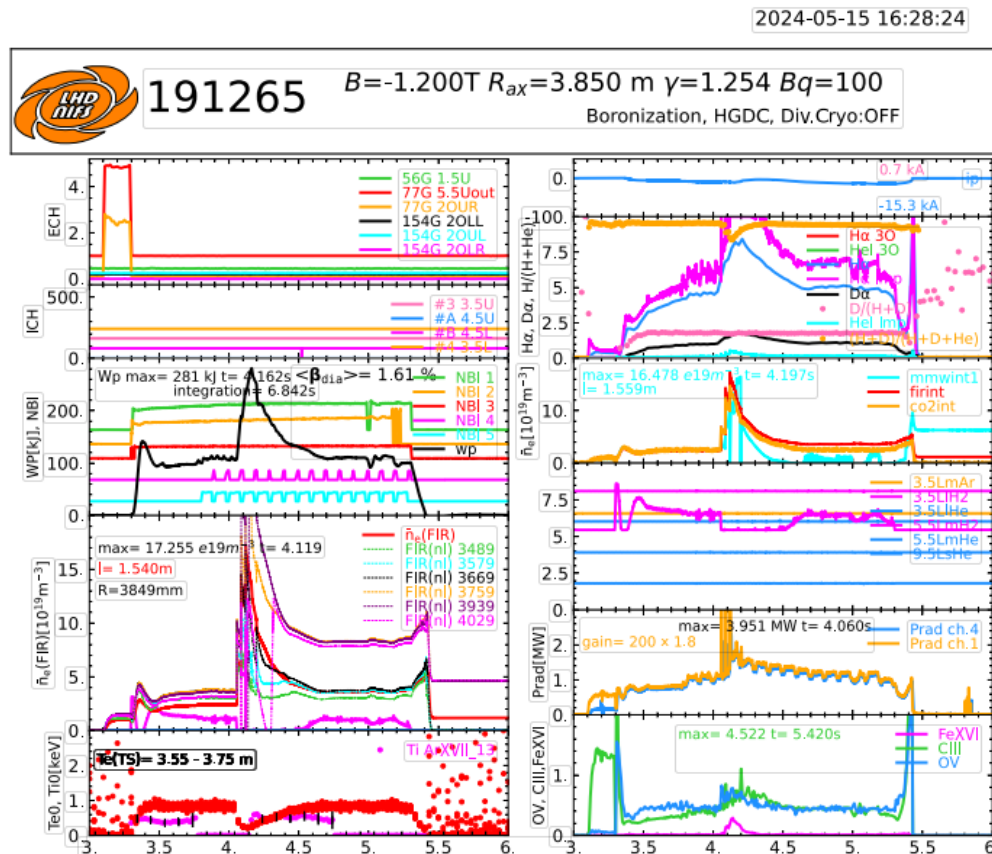
## Experimental conditions:

$(R_{ax}, \text{Polarity}, B_t, \gamma, B_q) = (3.85/3.90 \text{ m}, \text{CCW}, -1.2 \text{ T}, 1.254, 100)$   
(#191225 - #191270)

## Objective:

Utilize MSE diagnostic to study iota effects for core-density crashes (CDCs) and comparison to W7-X post-pellet MHD events (continuation of proposal\_23\_002302)

(H. Thomsen, Y. Suzuki, M. Yoshinuma, Y. Takemura)



## Results:

- ✓ Scan of two  $R_{ax}$ -positions successfully taken.
- ✓ LHD191265 ( $R_{ax}=3.85\text{m}$ ):  
CDC after 3 pellets
- ✓ LHD191270 ( $R_{ax}=3.90\text{m}$ ):  
CDC after 3 pellets
- ✓ MSE data is available (needs analysis)
- ✓ Also interesting for analysis:  
191238 & 191238: 5 or 6 pellets with CDC

# Background: Core Density Crash dynamics and rotational transform

[S. Bozhnikov et al., NF 2020]

- Balloning modes are found as precursor to CDCs [S. Ohdachi et al., NF 2017]
  - For certain cases, also  $m=1$  mode observed [S. Ohdachi et al., CPP 2010]
  - Apparent similarity of CDC in LHD and collapse in W7-X high-performance discharges with pellet-fueling
  - Question: can we improve the understanding by improved MSE diagnostic capability
- Find indications of iota-dependency
- Resolve the CDC dynamics

