(TG4) Plasma instability group report

Nov. 2, 2022 (N. Kenmochi)

Date: Nov.1, 2022
Time: 9:35 -13:05, 16:50-18:45
Shot#: 182035-182098, 182158-182195 (102 shots)

Prior wall conditioning: No

Divertor pump: On
Gas puff: D2, Ar Pellet: TESPEL(W)
NBI#(1, 2, 3, 4, 5)=gas(D, D, H, D, D)=P(2.5, 2.2, 3.7, 0, 0)MW
ECH(77GHz)=ant(5.5-Uout (or 1.5U), 2-OUR)=P(0.70, 0.79)MW
ECH(154GHz)=ant(2-OLL, 2-OUL, 2-OLR)=P(0.72, 0.80, 0.83)MW
ECH(56GHz)=ant(1.5U)=P(0)MW
ICH(3.5U, 3.5L, 4.5U, 4.5L)=P(0.79, 0.68, 0.78, 0)MW
Neutron yield integrated over experiment = 3.4×10^{16}

Topics
1. Investigating the impact of combined neutral beam and electron cyclotron induced currents on the AEs activity in low density hydrogen plasmas. (A. Cappa)
2. Mitigation of tungsten induced plasma termination and identification of transient transport mechanisms (A. Dinklage)

Impact of combined NB and EC induced currents on AEs activity (A. Cappa, J. Varela, K. Nagaoka)

Shot #: 182049-182097

Experimental conditions:

(R_{ax}, Polarity, B_t, γ, B_q) = (3.55, CCW, 1.375, 1.2538, 100), (3.75, CCW, 1.375, 1.2538, 100),

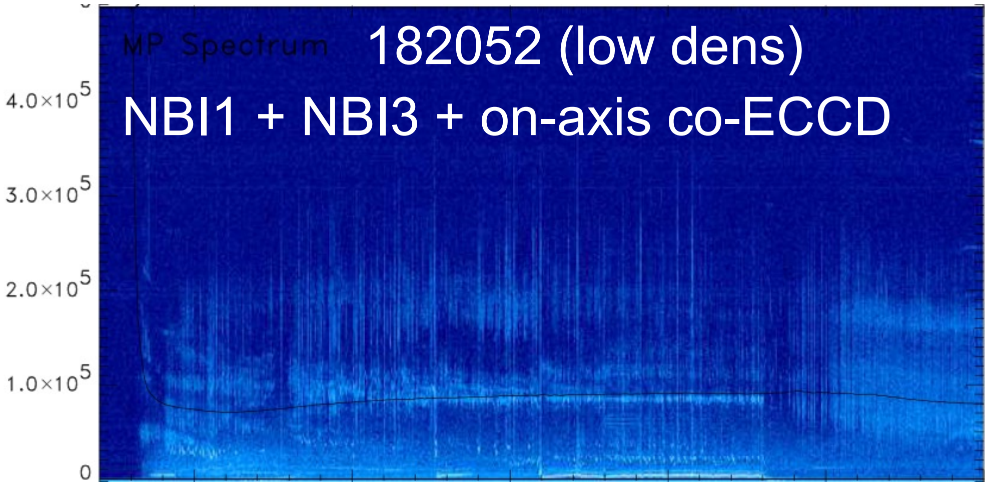
Background and motivation:

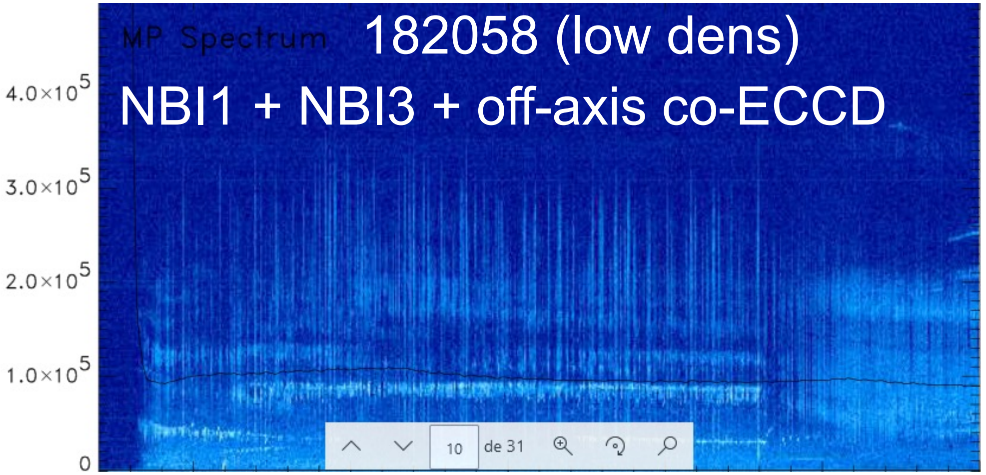
- Plasma current has strong influence on SAS.
- Combine NBCD and ECCD to obtain maximum changes in rotational transform and investigate mode activity.
- Validation of gyro-fluid simulations with FAR3D.

Results for Rax = 3.55 m:

- Strong co-current (NBCD+on/off ECCD is achieved and shows more intense AES activity in the off-axis case).

(R_{ax}, B_t) = (3.55m, 1.375T)





Impact of combined NB and EC induced currents on AEs activity (A. Cappa)

Shot #: 182049-182097

Experimental conditions:

(R_{ax}, Polarity, B_t, γ, B_q) = (3.55, CCW, 1.375, 1.2538, 100), (3.75, CCW, 1.375, 1.2538, 100),

Background and motivation:

- Plasma current has strong influence on SAS.
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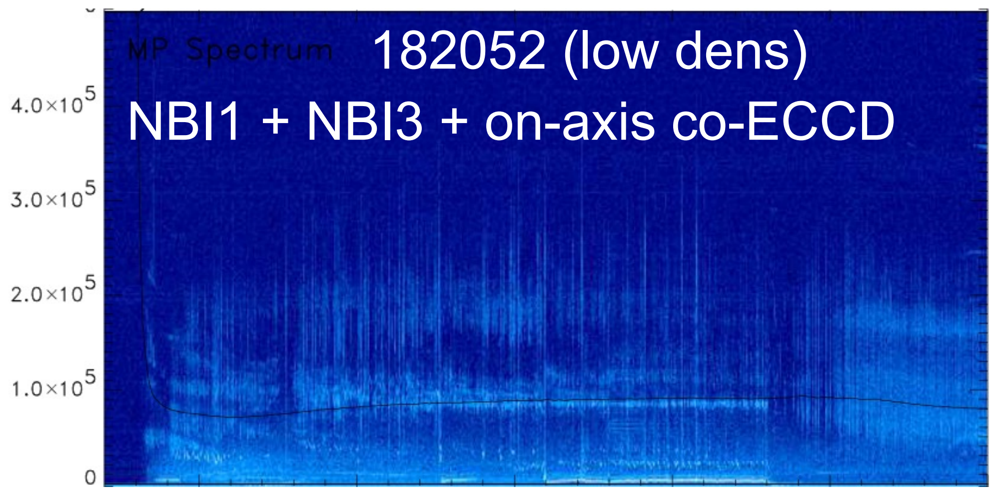
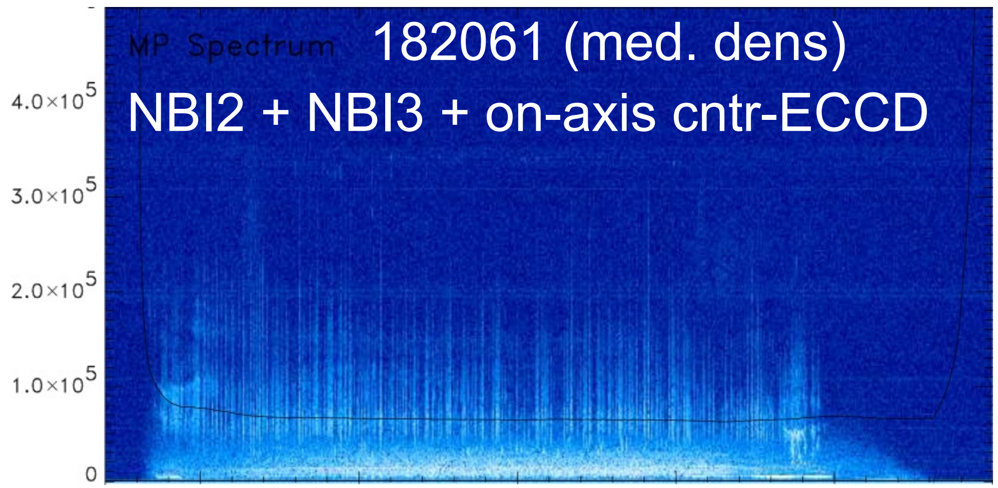
Results for Rax = 3.55 m:

- Strong co-current (NBCD+on/off ECCD is achieved and shows more intense AES activity in the off-axis case).
- A wide range of plasma current scan was carried out, but the plasma current range shifted in co-direction due to NBI#3 injection for MSE diagnostic.
- For balanced current, strong pressure gradient driven modes appear.

(R_{ax}, B_t) = (3.55m, 1.375T)





Rax	Heating sequence	Pattern	ECCD on/off-axis	Dens. (10**19 m-3)	#	ALL FORESSEN DISCHARGES WERE PERFORMED
3.55	ECRH start-up (0.3 s) **NBI2 (2s) + cntr-ECCD (2s)**	**A**	**on-axis cntr-ECCD**	**0.5 1.0 / FIDA 1.5**	**3+1(FIDA)**	**128064 061/066 062**
		B	**off-axis cntr-ECCD (ρ = 0.3)**	0.5	**1**	**067**
	ECRH start-up (0.3 s) **NBI2 (2s) + co-ECCD (2s)**	**C**	**on-axis co-ECCD**	0.5	**1**	**070**
		D	**off-axis co-ECCD (ρ = 0.3)**	0.5	**1**	**071**
	ECRH start-up (0.3 s) **NBI1 (2s) + co-ECCD (2s)**	**E**	**on-axis co-ECCD**	**0.5 1.0 / FIDA 1.5**	**3+1(FIDA)**	**052 054/057 051**
		F	**off-axis co-ECCD (ρ = 0.3)**	0.5	**1**	**059**
	ECRH start-up (0.3 s) **NBI1 (2s) + cntr-ECCD (2s)**	**G**	**on-axis cntr-ECCD**	0.5	**1**	**072**
		H	**off-axis cntr-ECCD (ρ = 0.3)**	0.5	**1**	**073**
	MSE calib					**047 / 048**
3.75	ECRH start-up (0.3 s) **NBI2 (2s) + cntr-ECCD (2s)**	**A**	**on-axis cntr-ECCD**	**0.5 1.0 w/ FIDA 1.5**	**3+1(FIDA)**	**084 082 085**
		B	**off-axis cntr-ECCD (ρ = 0.3)**	**1.0 w/ FIDA**	**1**	**088**
	ECRH start-up (0.3 s) **NBI2 (2s) + co-ECCD (2s)**	**C**	**on-axis co-ECCD**	0.5 **w/ FIDA**	**1**	**094**
		D	**off-axis cntr-ECCD (ρ = 0.3)**	0.5 **w/ FIDA**	**1**	**093**
	ECRH start-up (0.3 s) **NBI1 (2s) + co-ECCD (2s)**	**E**	**on-axis co-ECCD**	**0.5 w/ FIDA 1.0 w/ FIDA 1.5 w/ FIDA**	**3+1(FIDA)**	**090 089 091**
		F	**off-axis co-ECCD (ρ = 0.3)**	0.5 **w/ FIDA**	**1**	**092**
	ECRH start-up (0.3 s) **NBI2 (2s) + cntr-ECCD (2s)**	**G**	**on-axis cntr-ECCD**	0.5 **w/ FIDA**	**1**	**096**
		H	**off-axis cntr-ECCD (ρ = 0.3)**	0.5	**1**	**097**
	MSE calib.					**079 / 080**

Research Proposal 24/002517: *Mitigation of tungsten induced plasma termination and identification of transient transport mechanisms*

Debriefing of Experiments Nov.01, 2022

A. Dinklage (IPP), N. Tamura (NIFS), H. Bouvain (IPP), R. Bussian (IPP), H. Kasahara (NIFS), K. McCarthy (CIEMAT), D. Medina (CIEMAT)

Wendelstein 7-X

This work has been carried out within the framework of the EUROfusion Consortium, funded by the European Union via the Euratom Research and Training Programme (Grant Agreement No 101052200 — EUROfusion). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Commission. Neither the European Union nor the European Commission can be held responsible for them.

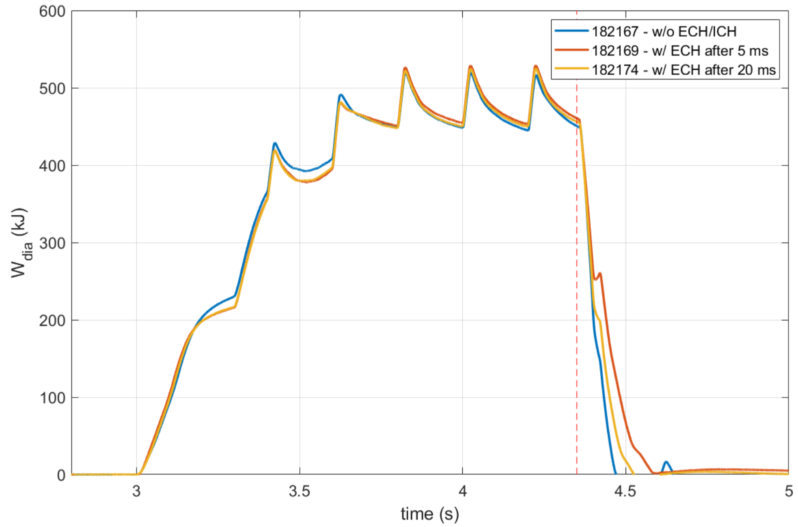
Aim of the experiment:

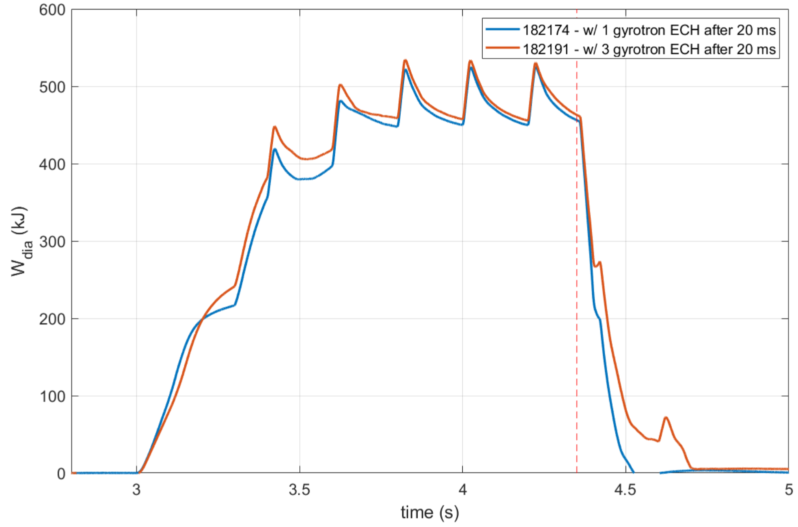
Investigate effect of additional heating on induced plasma termination TESPEL injection

Conducted experiments:

Magnetic config.: (Rax, Polarity, Bt, γ, Bq) = (3.60 m, CCW, 2.75 T, 1.2538, 100.0%)
Shots: #182159 - #182195; ECRH (~1.5 MW) heated

- 26 shots w/ 3×10^{17} W TESPEL (85% successful delivery)
- scan of delay time (from the time of TESPEL penetration) of additional ECH
  (~0.8 MW, Δt = 5, 10, 20, 40, 80 ms)
  (~2.3 MW, Δt = 5, 20, 80 ms)
- Scan of delay time (from the time of TESPEL penetration) with ICH
  (~2.3 MW, Δt = 5, 10, 20, 40 ms)
- Results show clear dependencies (next slide)





Some findings:

- ➢Additional ECRH migitates the induced thermal quench
- ➢finite optimum delay time: 5ms
- ➢Higher ECRH power prolongs the plasma decay
- ➢ICH has no effect

Additional (‚rescue‘) ECR heating mitigates Thermal quenches in stellarators