# (TG4) Plasma instability group report

Dec. 15, 2022 (N. Kenmochi)

Date: Dec.14, 2022
Time: 9:45 -11:20, 12:50-13:10
Shot#: 185910-185942, 185964-185969(39 shots)

Prior wall conditioning: No

Divertor pump: On
Gas puff: H2, Ar  Pellet: H2
NBI#(1, 2, 3, 4, 5)=gas(H, H, H, H, H)=P(0, 3.9, 3.6, 0, 0)MW
ECH(77GHz)=ant(5.5-Uout (or 1.5U), 2-OUR)=P(0.70, 0)MW
ECH(154GHz)=ant(2-OLL, 2-OUL, 2-OLR)=P(0, 0, 0)MW
ECH(56GHz)=ant(1.5U)=P(0.0)MW
ICH(3.5U, 3.5L, 4.5U, 4.5L)=P(0, 0, 0, 0)MW
Neutron yield integrated over experiment = $1.2 \times 10^{13}$

## Topic

1. Study on ablation of solid hydrogen pellet and particle fueling (X. Dai)

# Study on ablation of solid hydrogen pellet and particle fueling

X.Dai[1], H.Yamada[1], R.Sakamoto[1,2], Y. Isobe[1]  [1]UTokyo, [2]NIFS

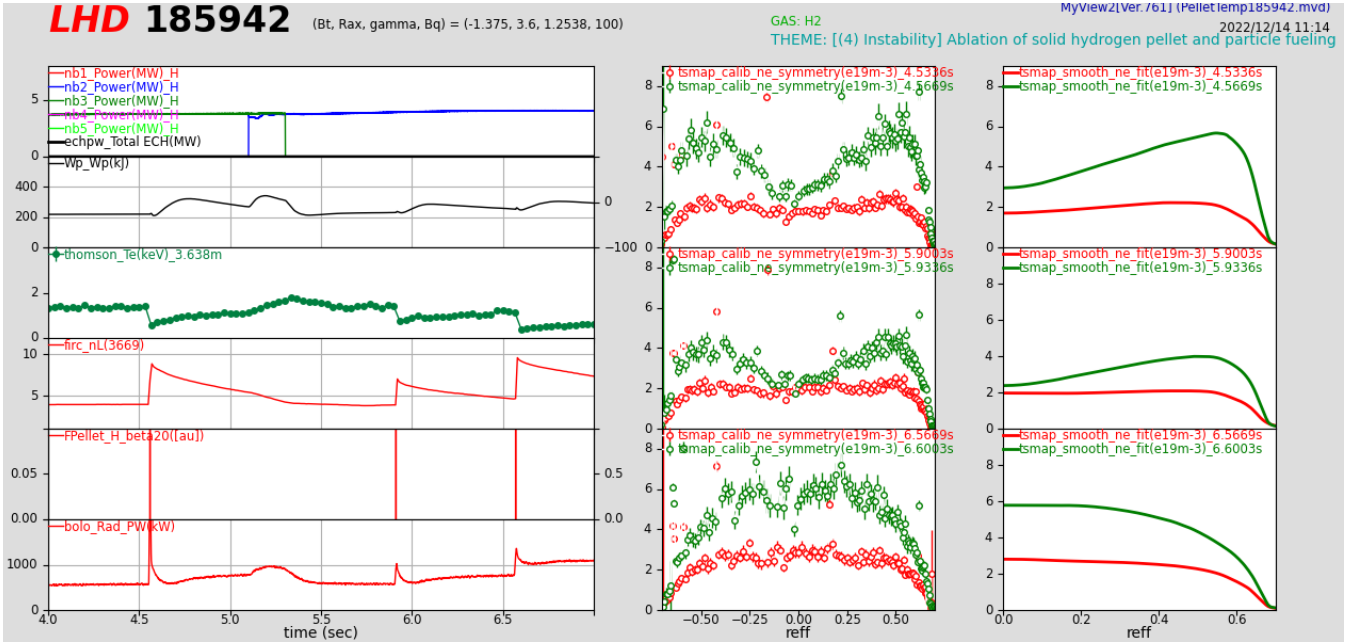
## Background and objective

- This study aims to comprehensively characterize pellet penetration and deposited particles towards clarification of particle transport and optimization of a fueling scheme/scenario in a fusion reactor.
- While the Neutral Gas Shielding (NGS) model gives a rough prediction of the penetration depth of a pellet, it misses important physical mechanisms such as shielding by plasmoid ablated from a pellet, drift motion, etc.
- Compilation of dataset of pellet injection/ablation with an accumulation of missing data, in particular, at 1.375 T. Also, fast Thomson scattering measurement is highlighted in looking into dynamics.

## Experimental Condition

■ $R_{ax}$=3.6m,

- NBI plasmas (#185915-185942) $B$=-1.375T
- ECH plasmas (#185964-185969, piggy-back) $B$=-2.75T
- Survey pellet velocity $V_p$ , and density $n_e$ and temperature $T_e$ of target plasmas




## Results

- For NBI plasmas: 618m/s < $V_p$ < 1305m/s,
  0.7 keV<$T_{e0}$<2.0 keV, 0.3×10$^{19}$m$^{-3}$ <$\bar{n}_e$< 6.4×10$^{19}$m$^{-3}$
- For ECH plasmas: 925m/s < $V_p$ < 1087m/s,
  4.8 keV<$T_{e0}$<5.5 keV, 1.7×10$^{19}$m$^{-3}$ <$\bar{n}_e$< 2.0×10$^{19}$m$^{-3}$

Exp. 2022/12/14

# Study on ablation of solid hydrogen pellet and particle fueling 2

**Results 2**

- Missing regime of magnetic field in the dataset
  has been filled at 1.375T

**Scope**

- The existing dataset has provided the scaling expression of penetration depth λ in NBI heated plasms:

$$\lambda / a \propto V_p^{0.25} T_{e0}^{-0.71} \overline{n}_e^{-0.43} B^{0.67} f_{ion}^{-0.26}$$

  where $f_{ion}$ is the fast ion population.
- It suggests significant contribution of magnetic field and fast ion population which are not included in the NGS model.
- Extended dataset will improve the quality of the assessment of contributions from $B$ and $f_{ion}$.
- Fast Thomson scattering measurement could yield a new physical insight of ablation process and subsequent particle deposition.

Correlation between leading parameters

existing dataset

newly obtained data on Dec.14,2022