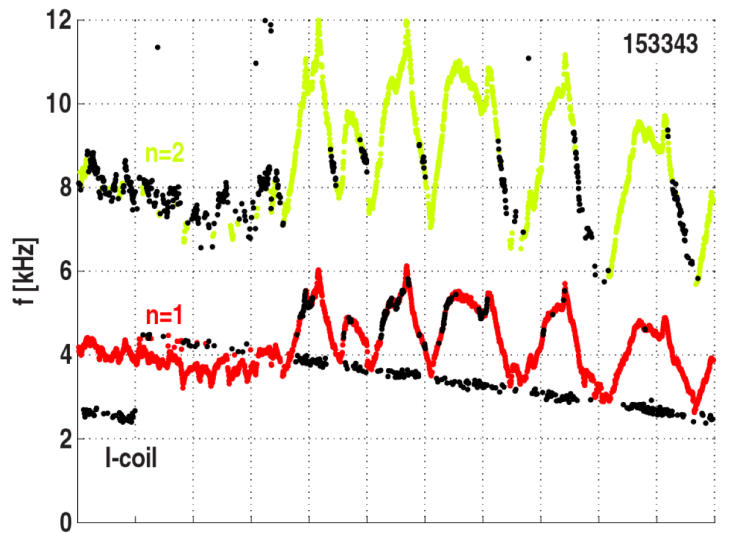
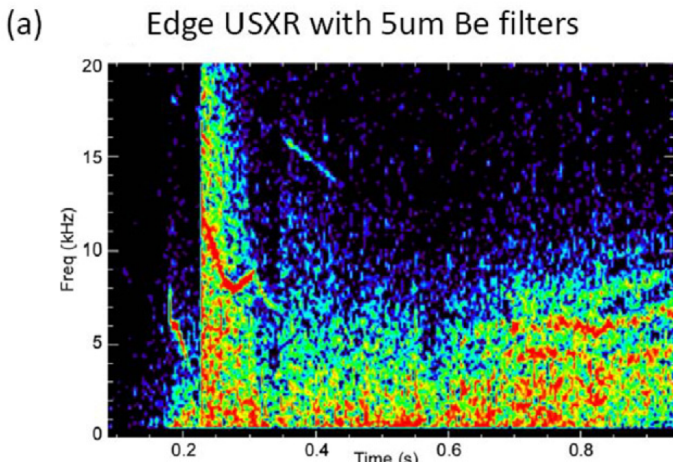


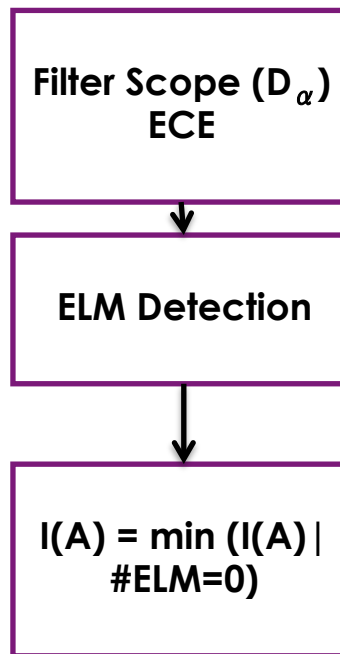
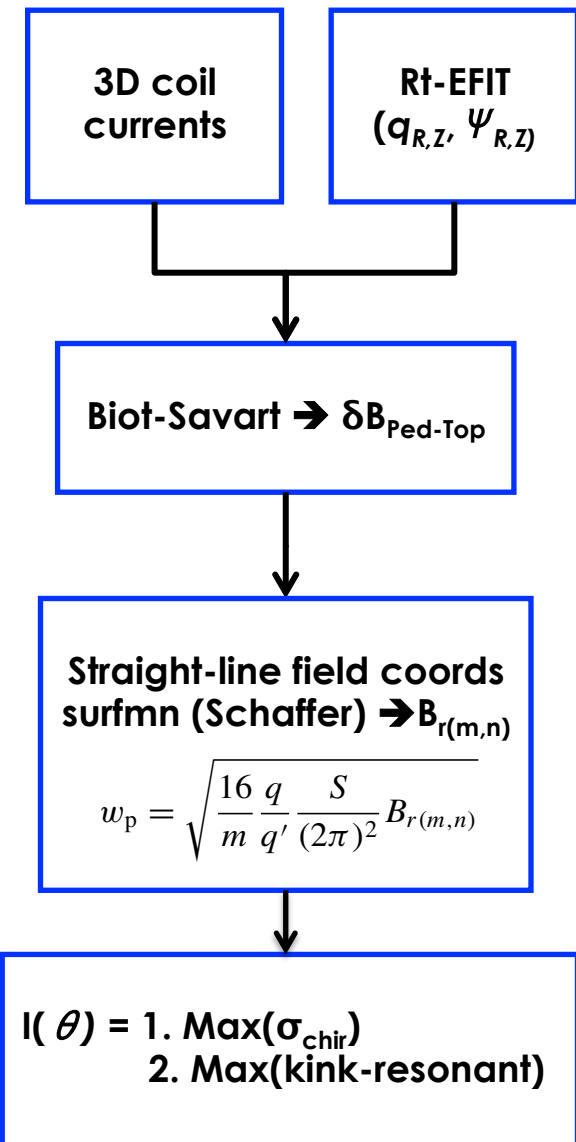
# Pedestal Control via 3D coils, gas, LGI and EHO coil

# EHO Coil Assessment: EHO 3D coil interaction

- Asses EHO Coil for NSTX-U
- Reduce the EHO frequency as low as possible (scenario development, magnetic braking). Can we get to 1kHz? There are some 1.5 KHz modes. Can the SPAs at all useful close to 1 kA?
- D3D, Lanctot initial I-coil EHO interaction

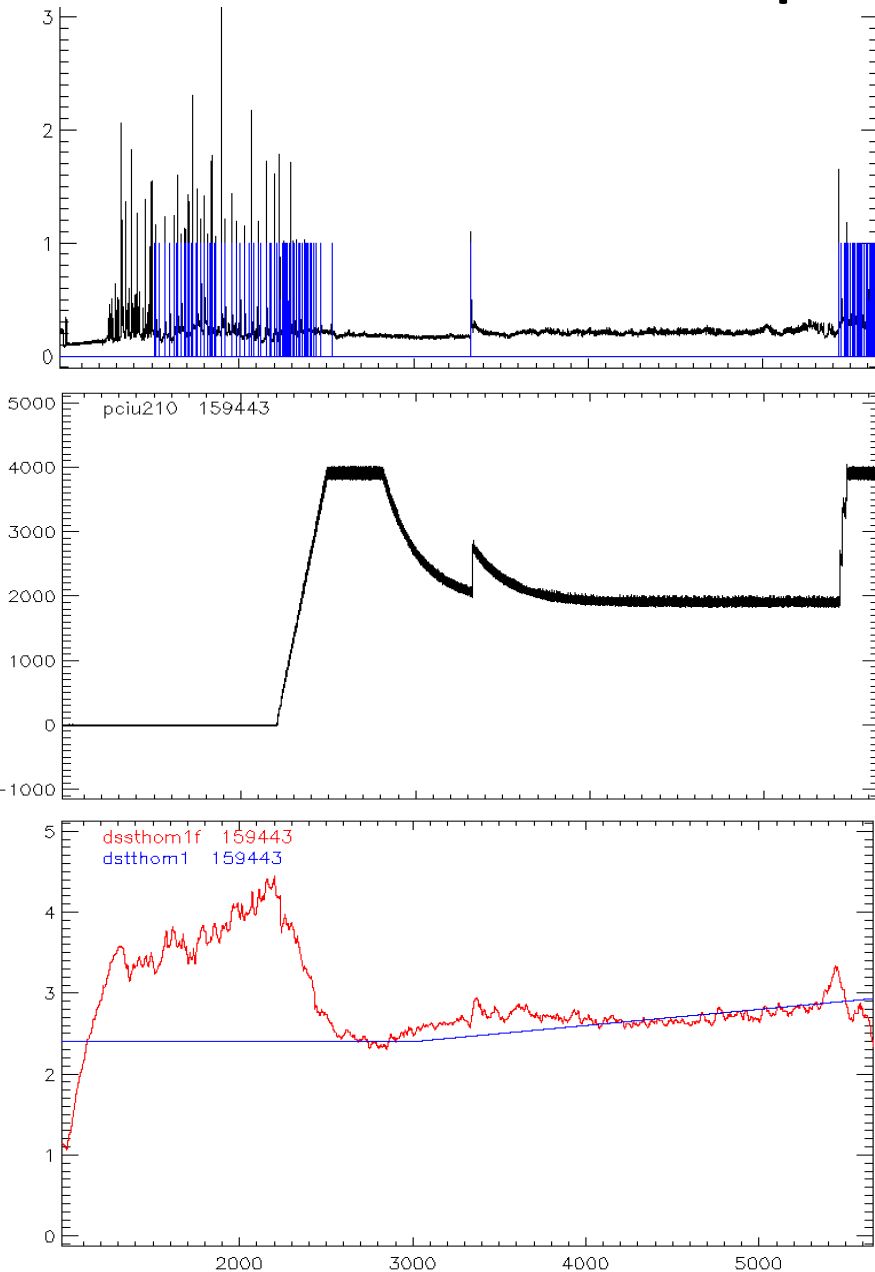


# Adaptive ELM Control



- In real-time calculate 3D perturbations due to 3D coils
  - Use surmf to convert to straight-line field coordinates
  - Find the orthogonal component  $B_{r(m,n)}$
  - Find the island size and  $\sigma_{chir}$
- Control:
  - Choose relative phase of the coils,  $I(\vartheta)$ , maximize kink or  $\sigma_{chir}$
  - The amplitude of current,  $I_c(A)$ , minimum current with no ELMs
- Test different ELM mitigation mechanisms

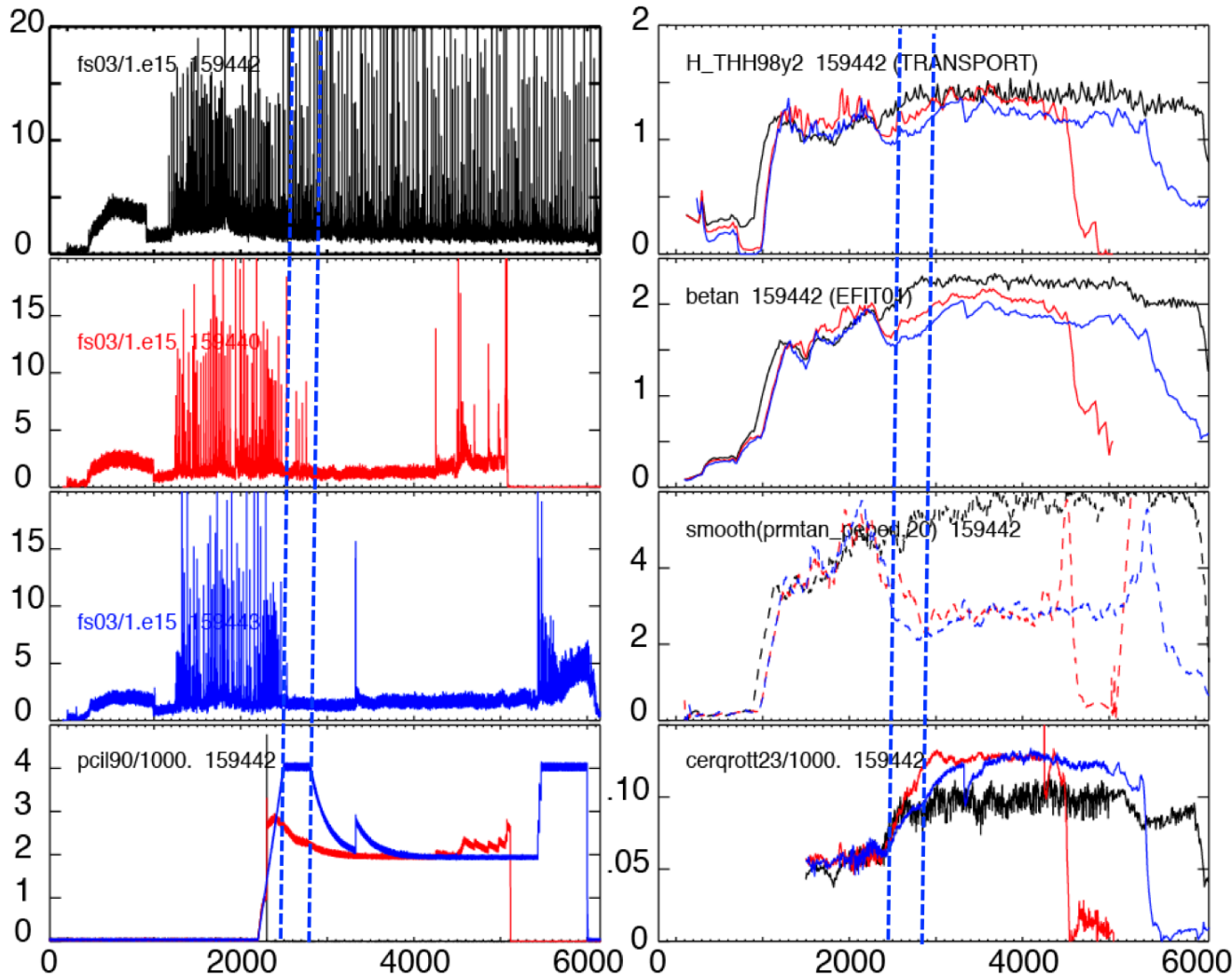
# Adaptive ELM Control



- Control the I coil amplitude based on the ELM frequency
- Control the pedestal density
- I coils adjust and keep ELM free with 1.9 kA (can go lower)
- When we reach a high density the ELMs come back again.  $\text{Prm\_tan\_ne} \sim 3.0 \times 10^{19}$
- Lock mode kills the plasma
  - Before control increase  $I_c$

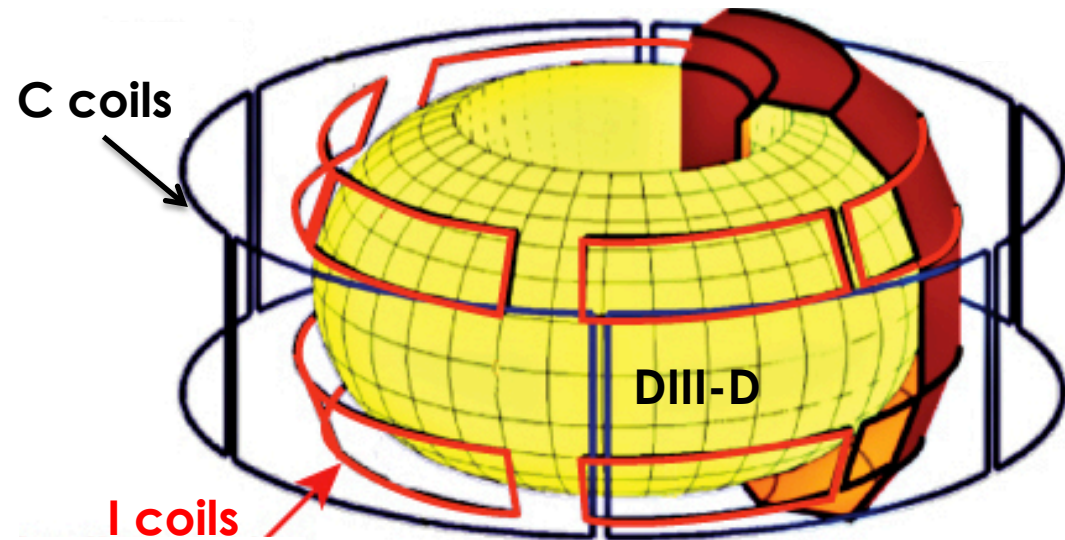
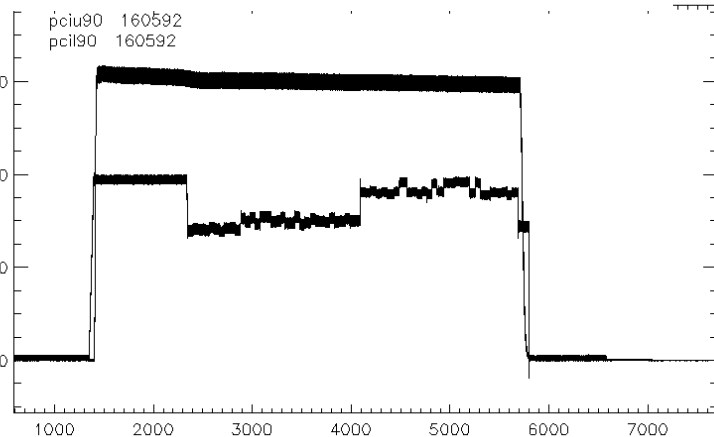
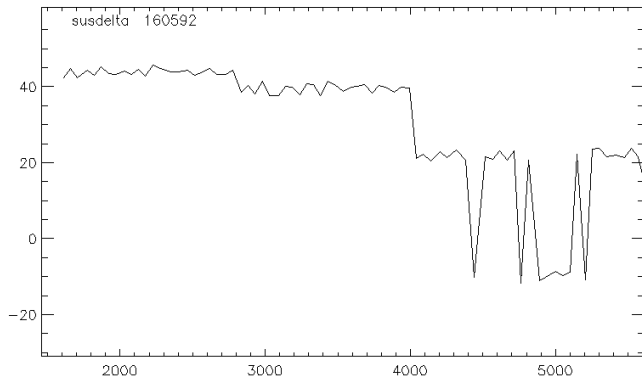
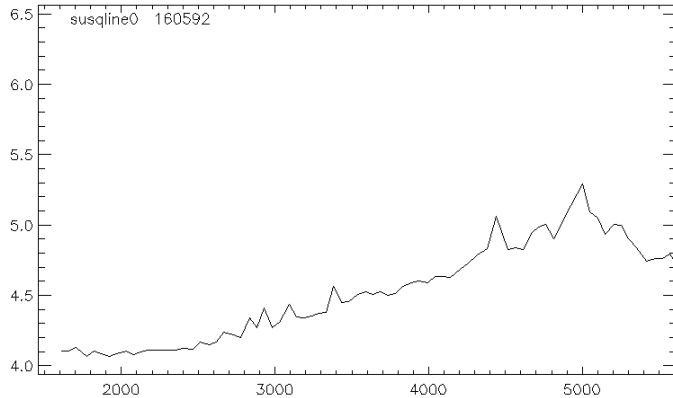
# Feedback of RMP Amplitude on ELM Size Shows Promising Increases in $H_{98}$ , $\beta_N$ , $p_e^{\text{ped}}$

Kolemen



- ELM suppression obtained with high I-coil current
- Feedback algorithm adjusts I-coil current down while maintaining suppression
- $H_{98}$ ,  $\beta_N$ , and  $p_e^{\text{ped}}$  increase
- Edge rotation increases substantially

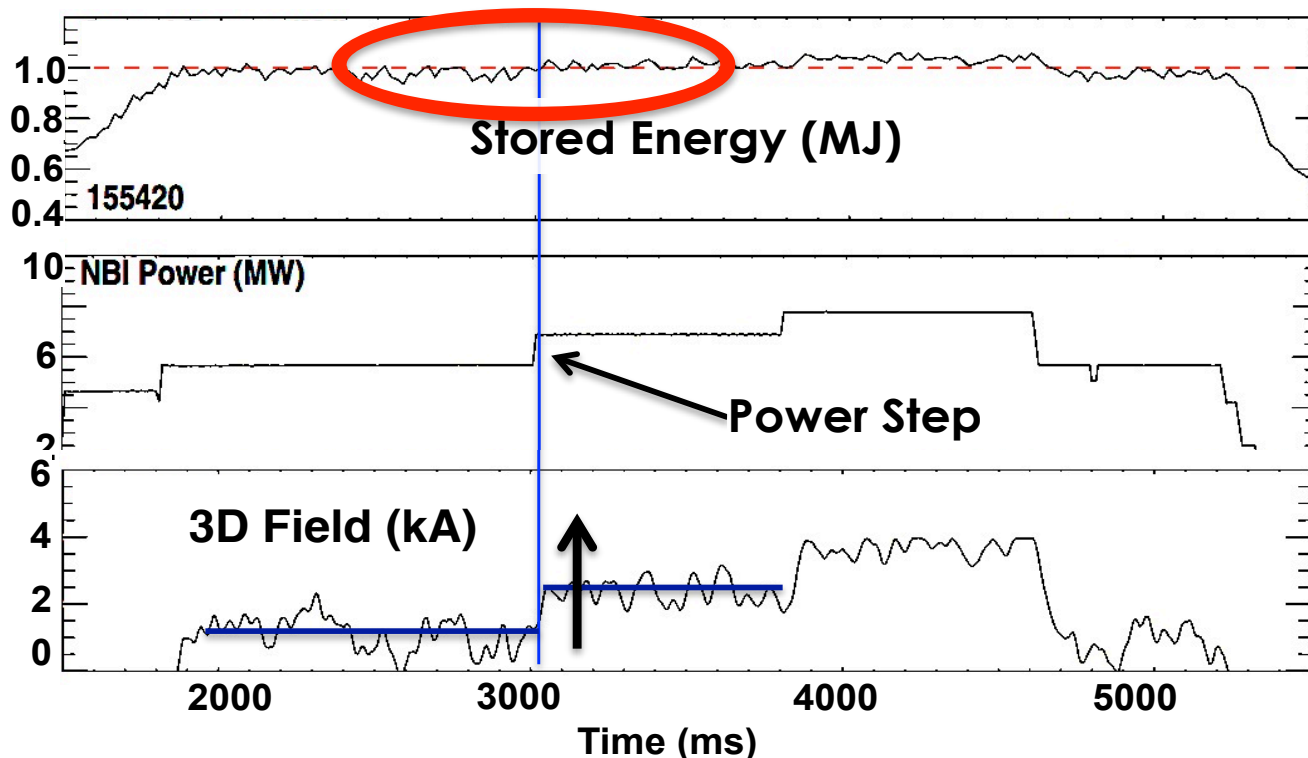
# Phase to Maximize the Kink Resonance at D3D



- Control the I coil phase based on the surfmn kink response calculations
- Choose the direction that maximizes kink response for phase
- Control the Icoil upper
- Too high density yesterday. Not possible to test n=2 ELM suppression
- Code checked out.

# Keep the Pedestal High but below the ELM limit by Pedestal Pressure Control with 3D Coils (RMP)

## 3D coil control for WMHD/BetaN



# Pedestal density/pressure control with LGI

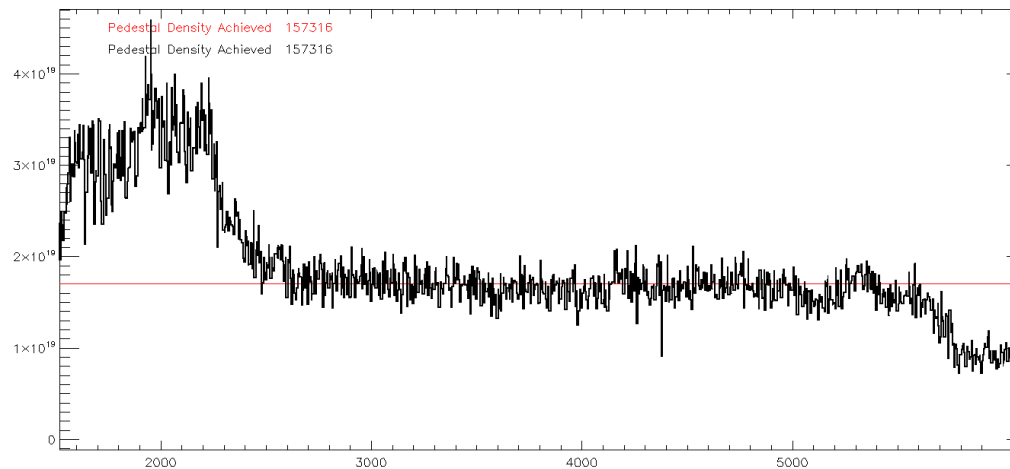
**Develop LGI, PCS connection. Adjust the density with LGI**

- 1. Try to adjust the ELM frequency in real-time (increase or reduce the ELM frequency to adjust the density)**
- 2. Turn on and off the LGI to keep density at a given level**



# Pedestal density/pressure control with gas

## Pedestal density/pressure control with gas



In the future, we can use Thomson. Initially, modeling of the pressure based on reconstruction.