Pedestal fueling variation in a closed divertor configuration at DIII-D

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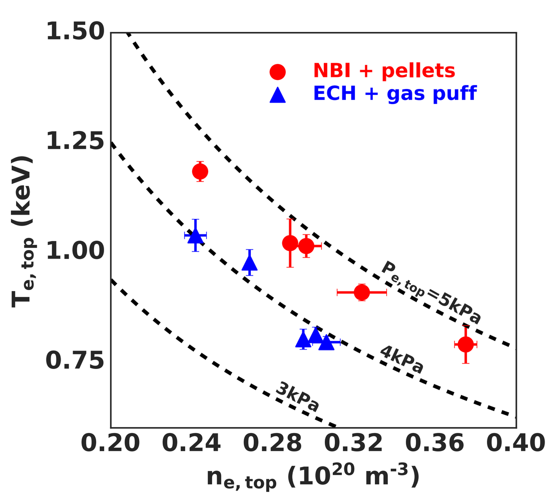
1. Motivation

- **GOAL:** determine the impact of particle source location on pedestal structure
- **Different fueling schemes** can vary the particle source profile:

  NBI + pellet injection vs. **NBI + ECH + gas puff**
- **Pedestal structure and stability affected**

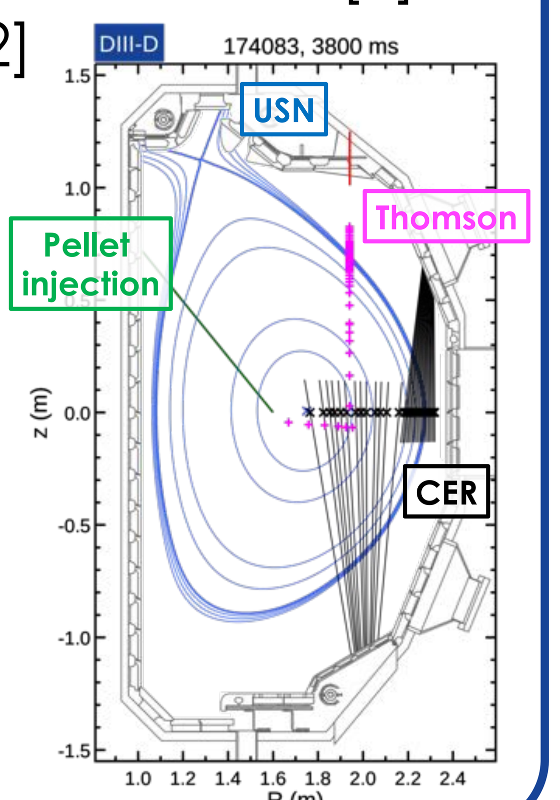
2. Experimental methods

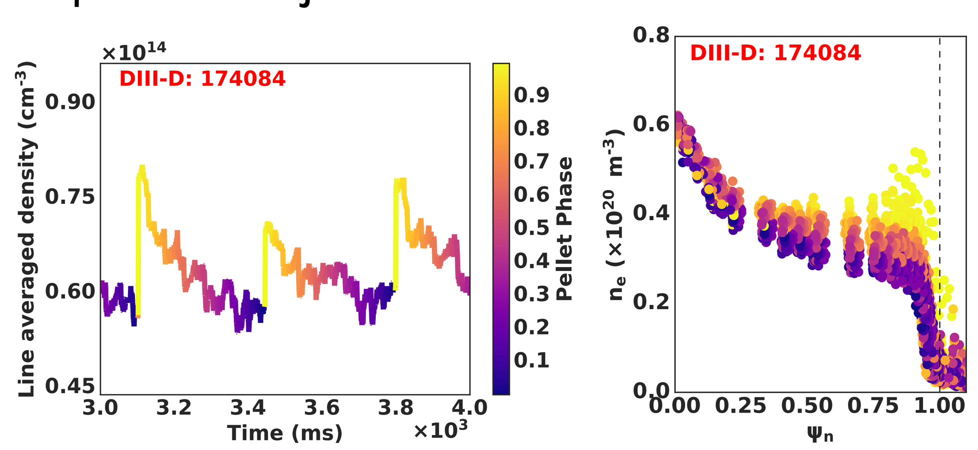
- Vary particle input for **different types of fueling**:
  - ➢ Pellets and gas puff used to vary the neutral fueling rate from 12 torrL/s to 42 torrL/s
- **Heating held constant** throughout all the shots
  - ➢ switched from dominant NBI to dominant ECH heating to avoid core fueling with gas shots



3. Analysis

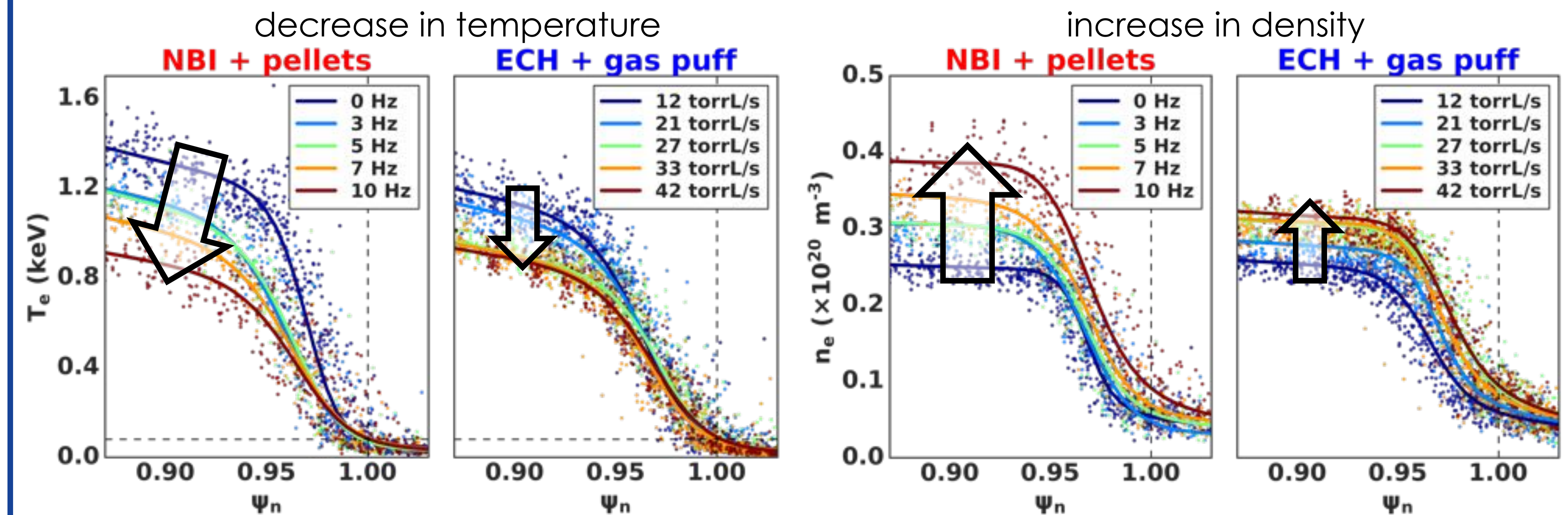
- Generation of kinetic equilibria with **CAKE** [1]
- Profile analysis: **OMFITprofiles** [2]
- Transport analysis with **TRANSP** [3] and **PELLET** [4]
- Filtering of ELM cycles and pellet injection time



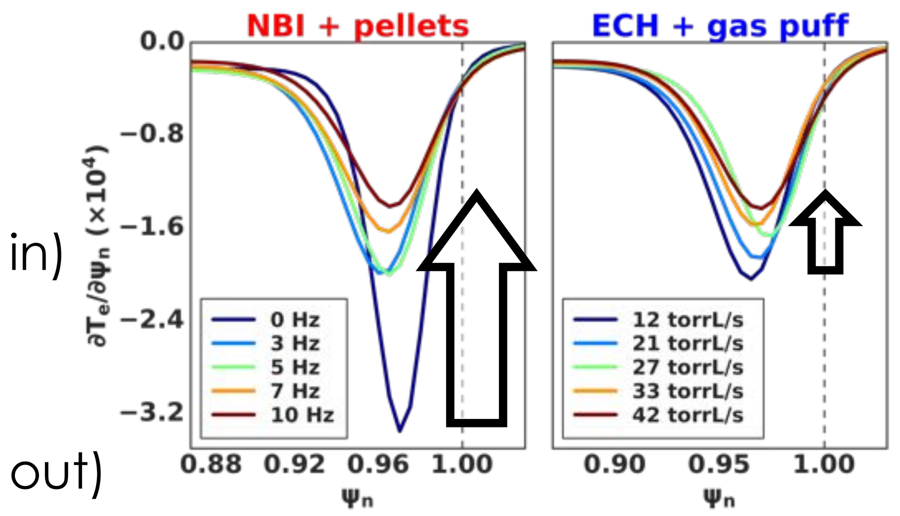


4. Pellet fueling changes the temperature gradient

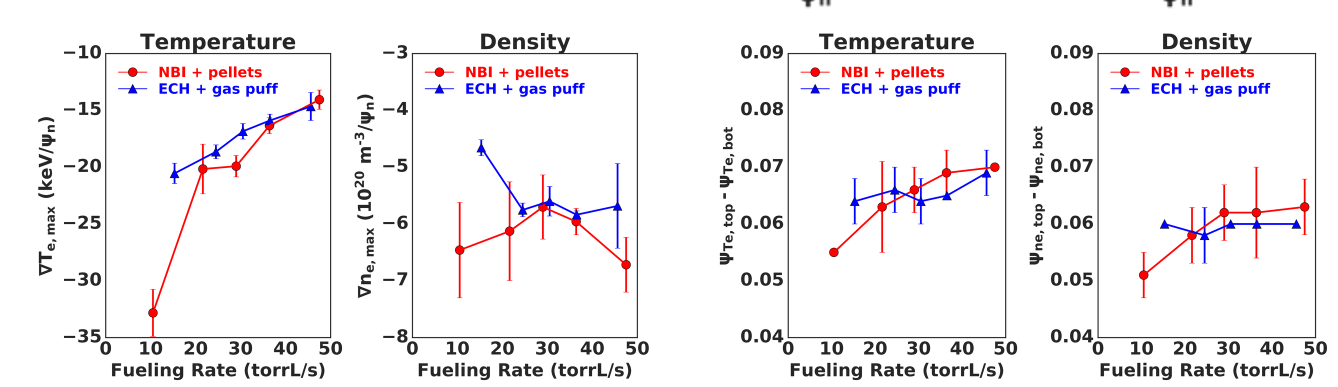
- Increased fueling at **constant pressure (limited by energy):**



- **Increased pellet injection:**
  - ➢ Increases the pedestal top density
  - ➢ **Flattens the temperature gradient**
    - → (more cold particles are deposited farther in)
- **Increased gas puff:**
  - ➢ Shifts the density profile radially outwards
    - → (more cold particles are deposited farther out)

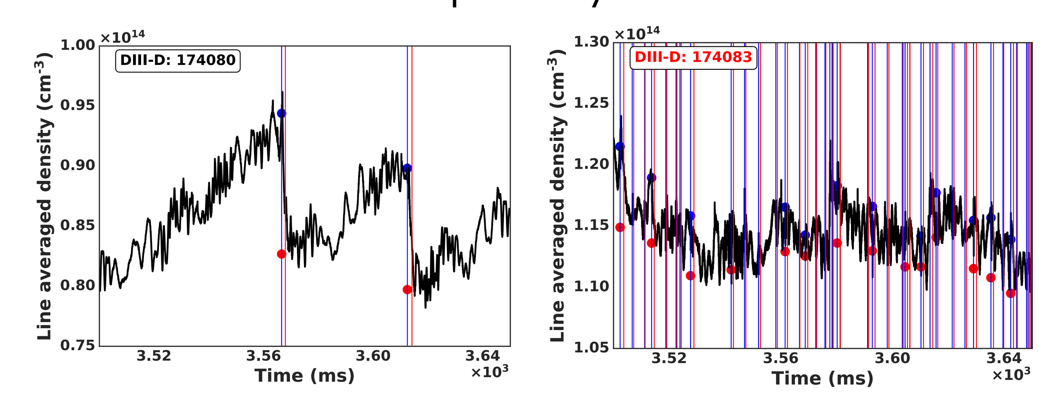


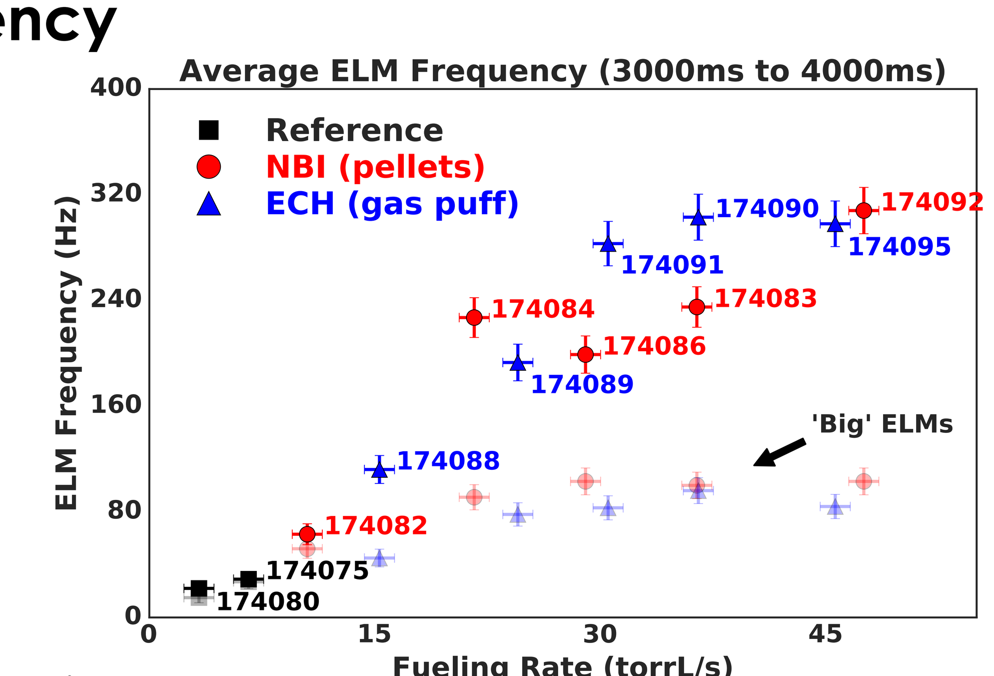
- **Pellets have a larger effect on pedestal gradient and width,** which leads to denser core plasmas



5. Increased fueling decreases ELM size

- **Higher fueling leads to higher ELM frequency**
  - ➢ Decrease in size of large ELMs
  - ➢ Increase in frequency of small ELMs

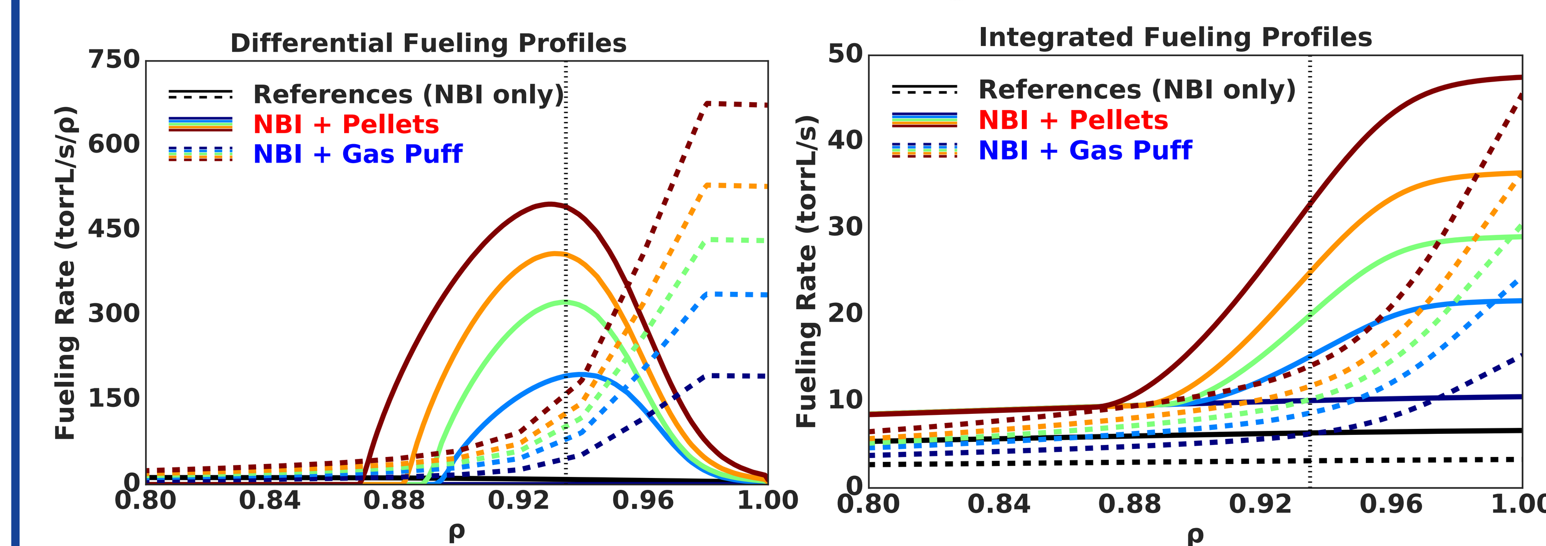




- **NBI-fueled cases have higher W_{MHD}**
  - ➢ Slightly different base plasma for the two fueling scans
  - ➢ NBI-fueled cases have a larger PM-stability region
    - → NBI responsible for better confinement, need to find other fueling scans

6. Fueling Profile Comparison

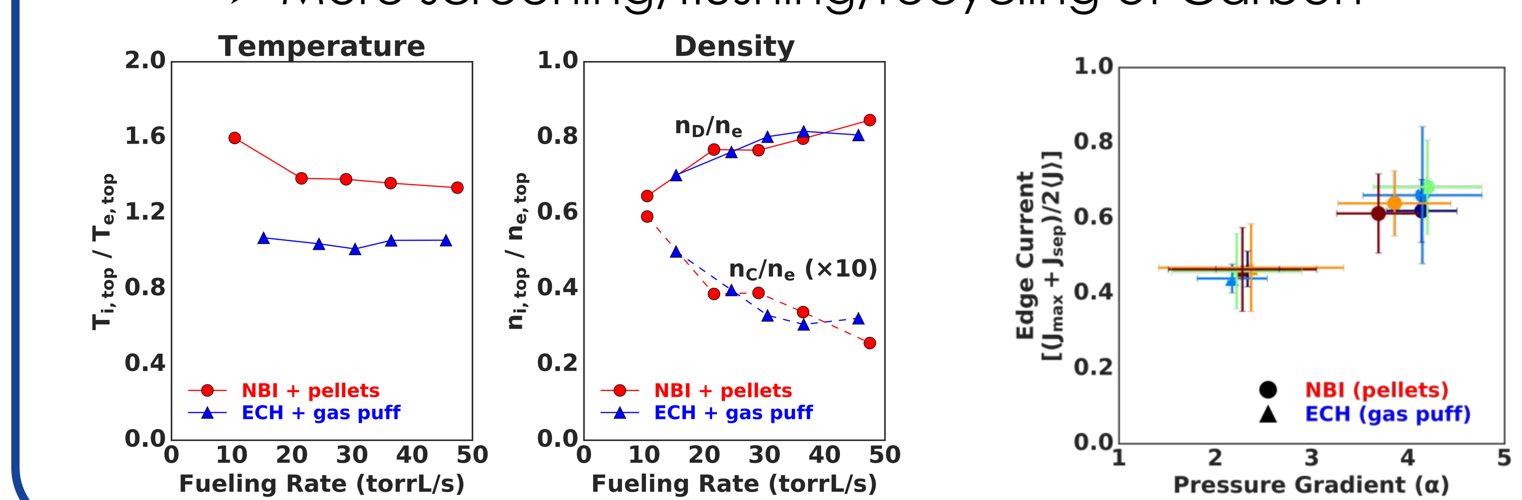
- **Pellets shift the neutral fueling profile inwards:**



- Must consider recycling + gas puff losses in SOL

7. Fueling reduces impurities

- Impurity ion temperature and density both **decrease with increased fueling**
- **Higher density leads to cleaner plasmas**
  - ➢ More screening/flushing/recycling of Carbon



8. Conclusions

- At **constant pressure and stored energy**, a wide range of different fueling rates is shown to lead to **different pedestal gradients**
  - ➢ Different neutral fueling may change the transport
- **Pellets fuel further inside of the plasma**
  - ➢ Steeper and wider pedestals allow for greater fueling (higher density at constant pressure)
- **Further work necessary:**
  - ➢ Determination of transport properties from fueling profiles
  - ➢ Investigation of ion confinement
- **SOLPS modeling: UP11.00040 (Thursday)**

Acknowledgements/References

[1] D. Eldon, E. Kolemen, M. A. Roelofs, et al., "Development of an automatic kinetic equilibrium reconstruction workflow for tokamak plasma stability analysis", manuscript in preparation
[2] N. C. Logan, B. A. Grierson, S. R. Haskey, S. P. Smith, O. Meneghini & D. Eldon Fusion Science and Technology Vol. 0, Iss. 0, 2018
[3] B. A. Grierson, et. al.: Fusion Science and Technology Vol. 0, Iss. 0 (2018)
[4] W. Houlberg, S. Milora, S. Attenberger, Nuclear Fusion Vol. 28, 595 (1988)

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