Max-Planck-Institut
für Plasmaphysik

Need for ECRH power feedback on density profile.

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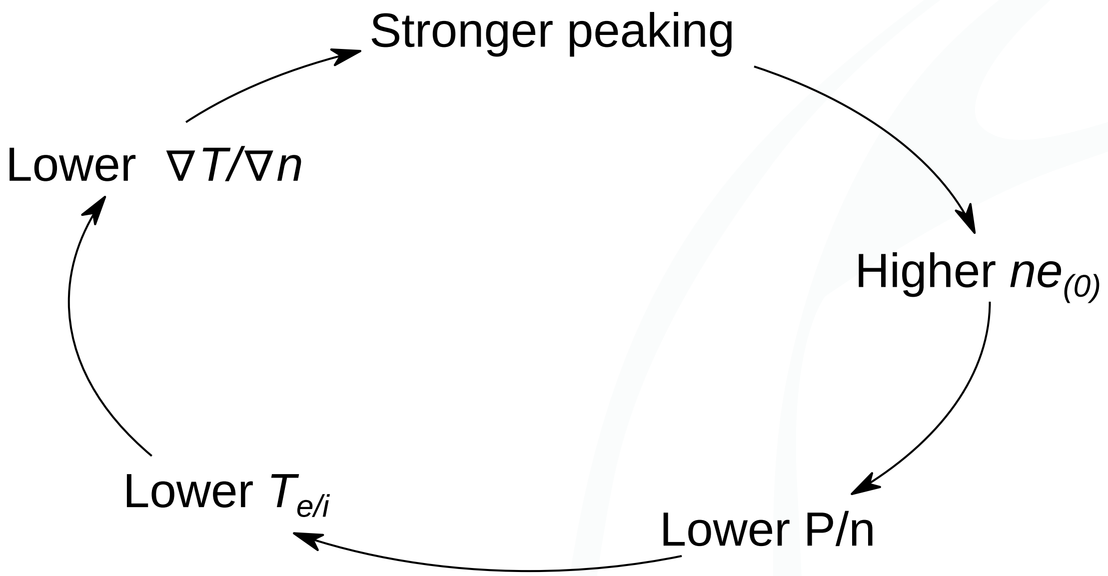
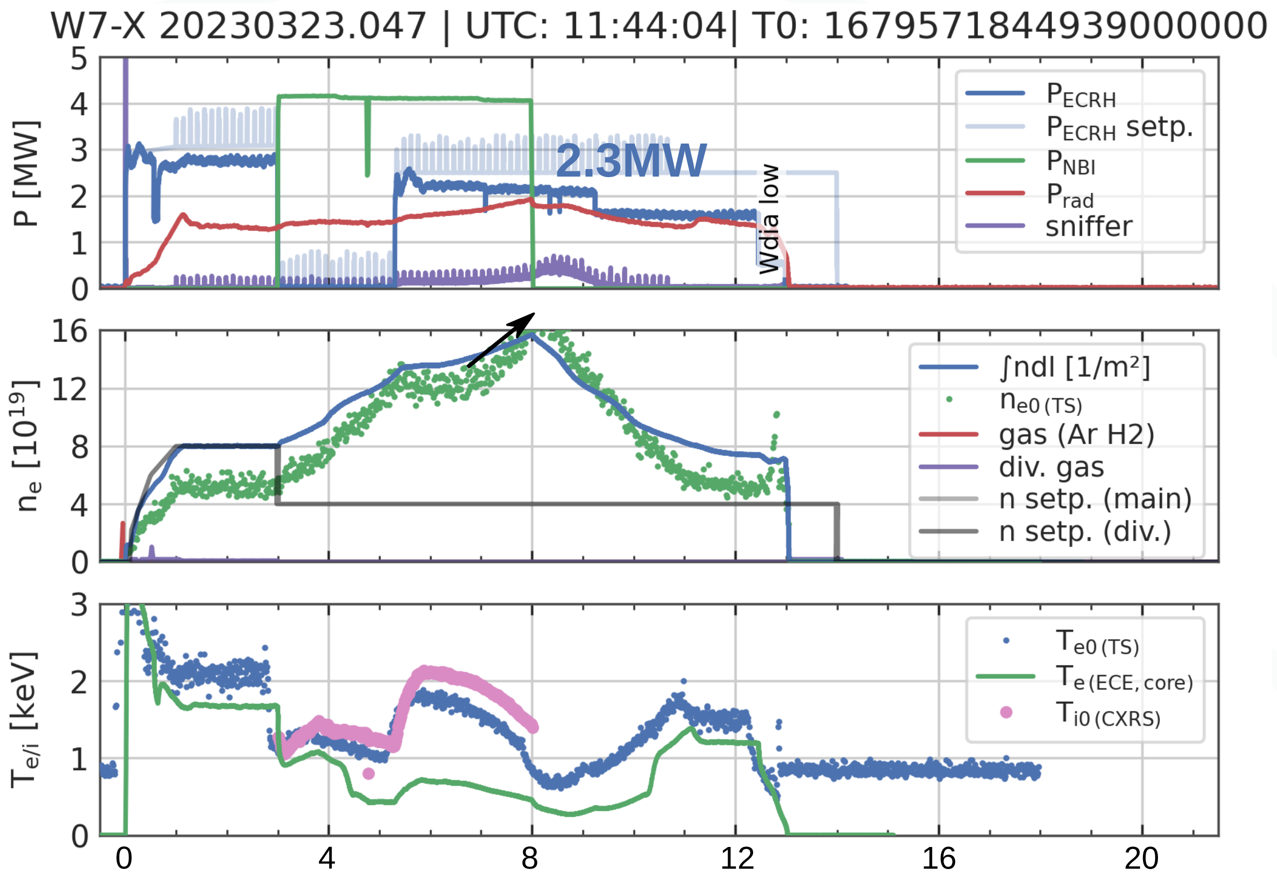
High Performance

- 'High-performance' (T_i, W_{dia}, β) require peaked density profiles.
- Peaked density profiles created with: NBI, pellets, TESPEL, Boron injection, intrinsic (low P) ....
- Supported by natural particle pinch, flattened by particle diffusion.
- We add O2 ECRH to take advantage of reduced heat transport, but raised ∇T flattened ∇n_e.

Situation is fundamentally unstable:





High Performance

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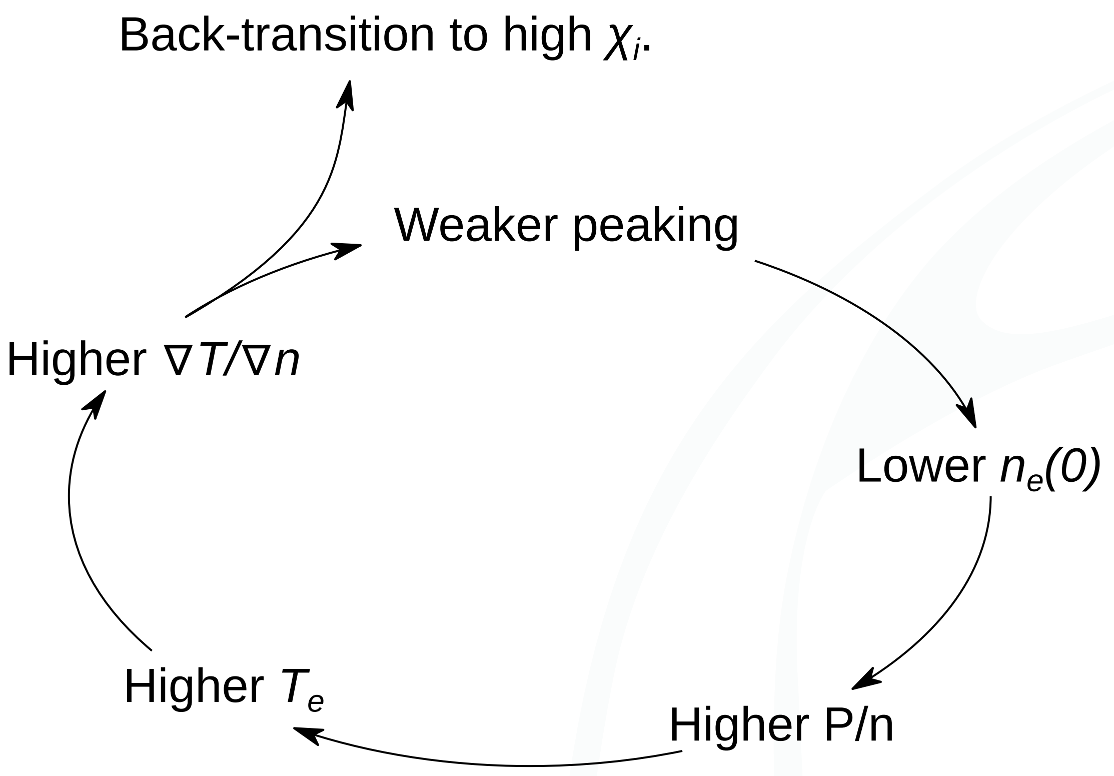
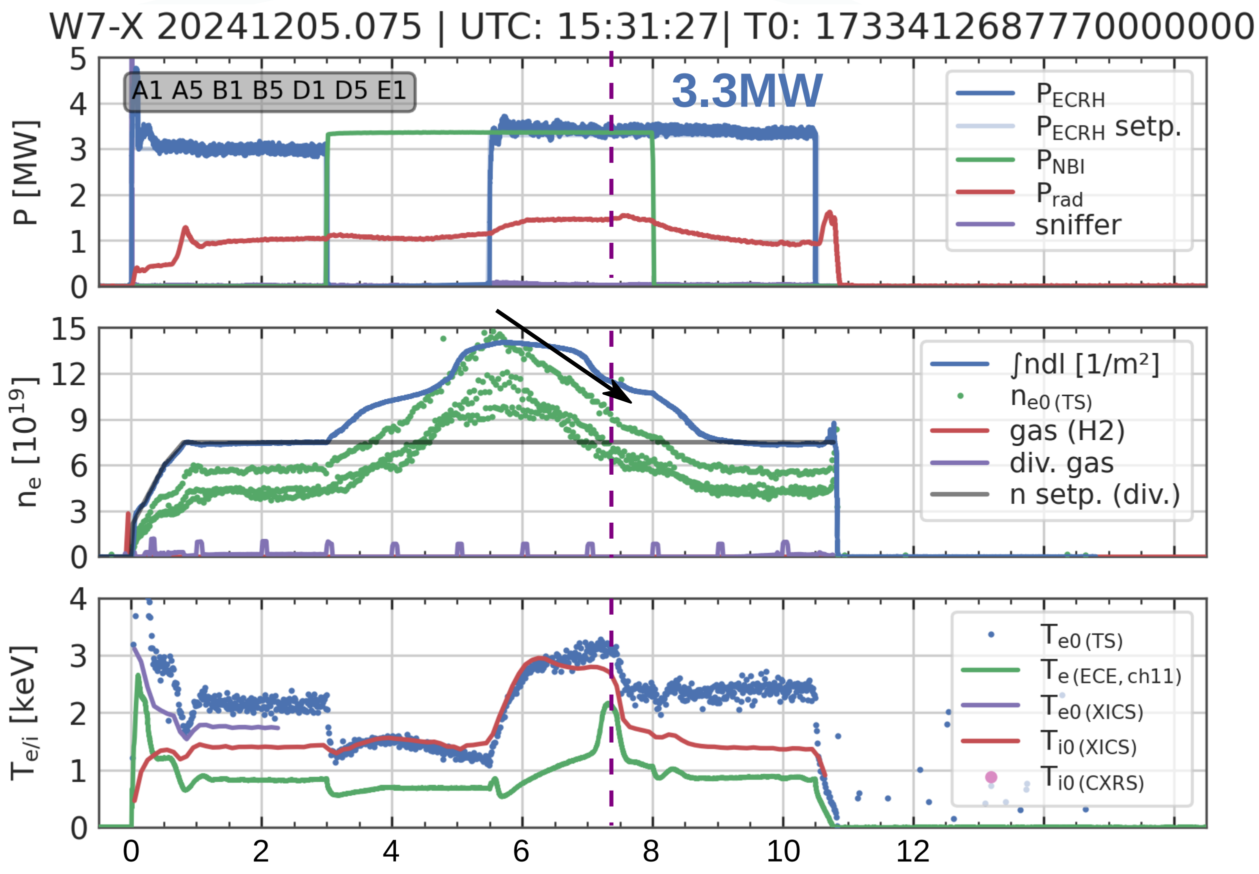




ECRH pump-out

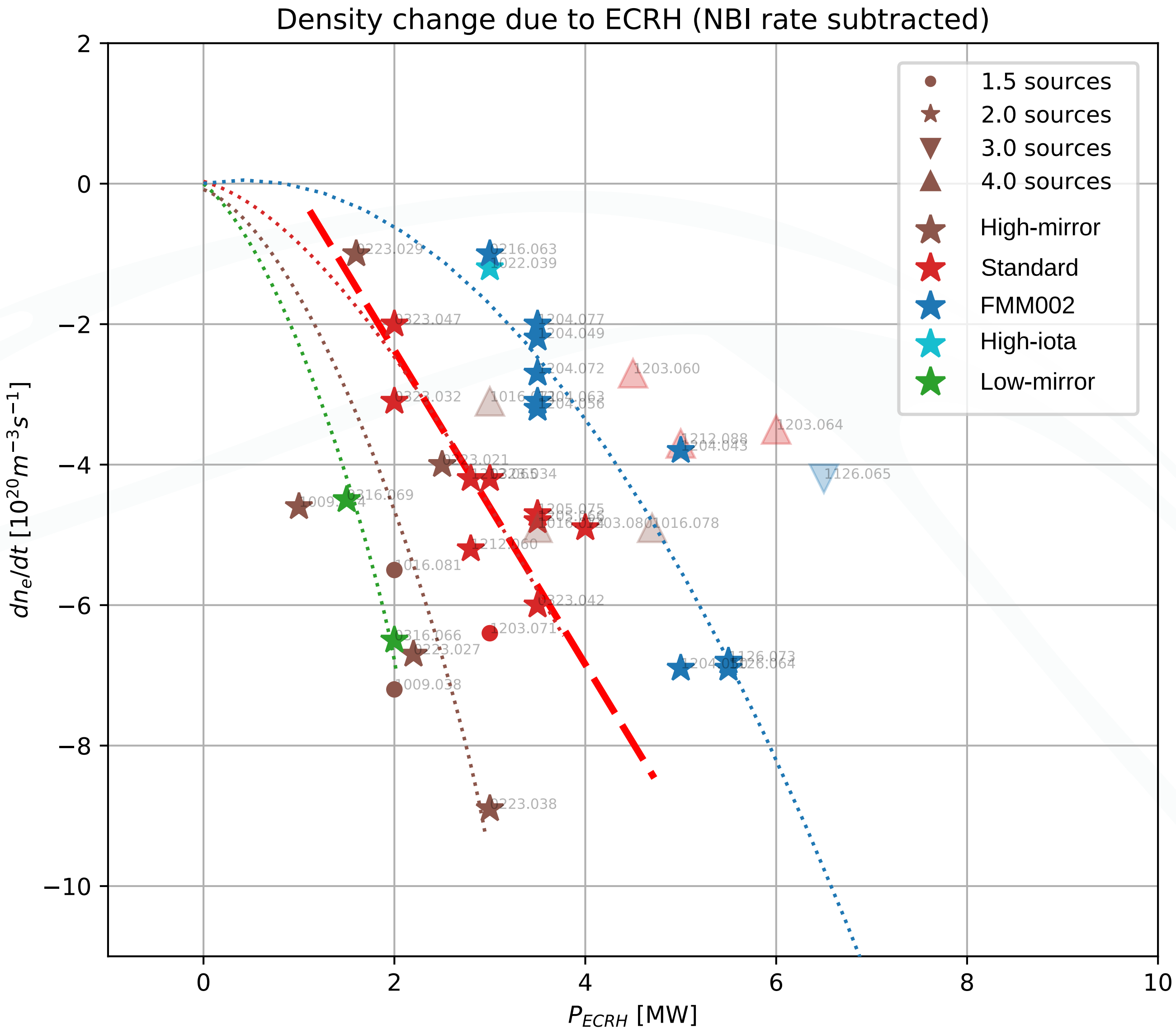
- ECRH 'pump-out' effect increase with more power. This doesn't seem to be linear.

- The effect is *very* configuration dependent.

- Balance point is roughly:
  - High/low mirror: ~1.5MW
  - Standard: ~2.3MW
  - FMM002: 3.5MW

For standard:

$dn/dt = -2.25\ P(MW)\ 10^{19}\ m^{-3}\ s^{-1}$

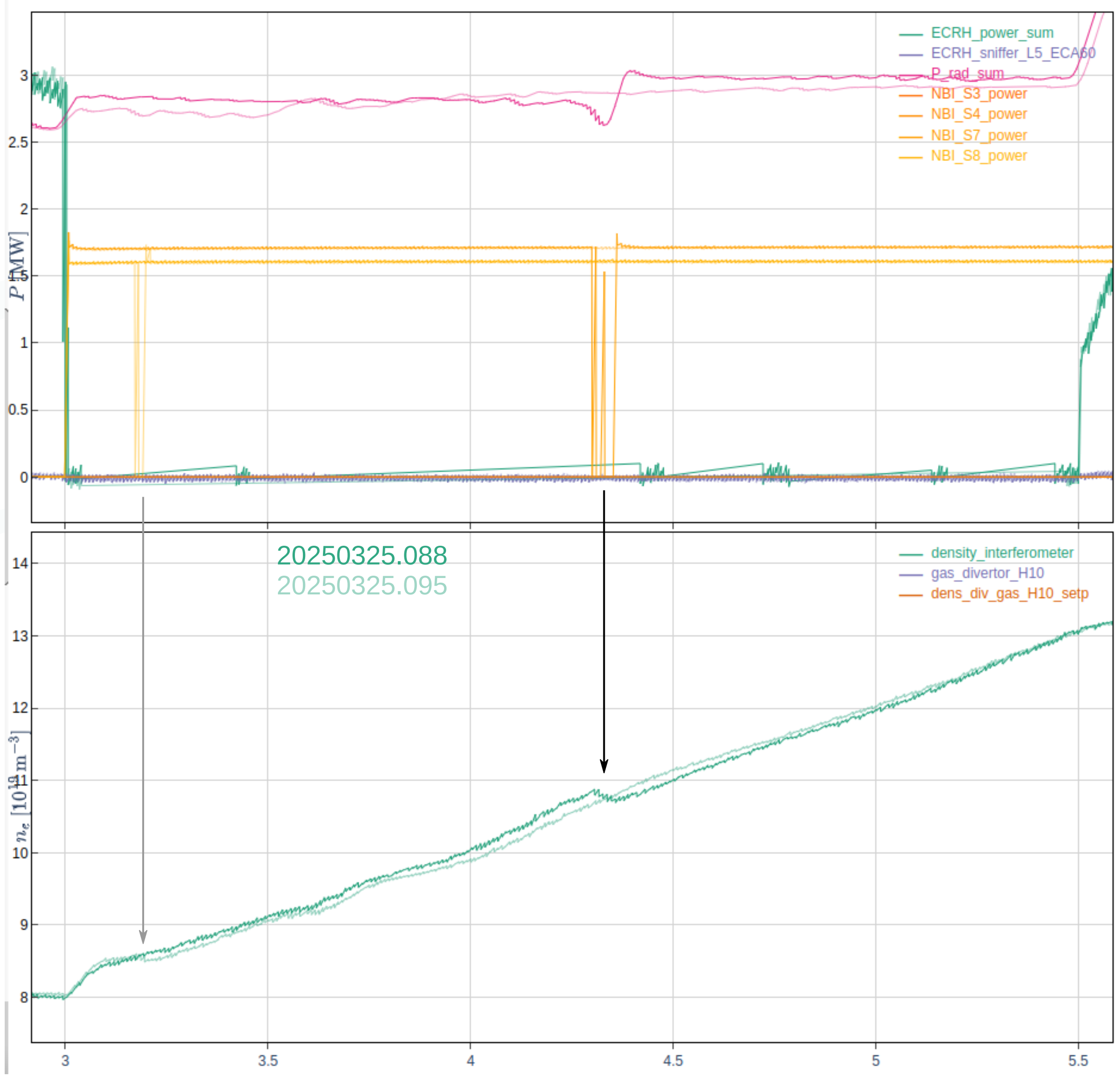


Complications

- Ideally feedback would be on ∇n or $n_e(0)$. Line. int. ne often signal much weaker and edge density changes.

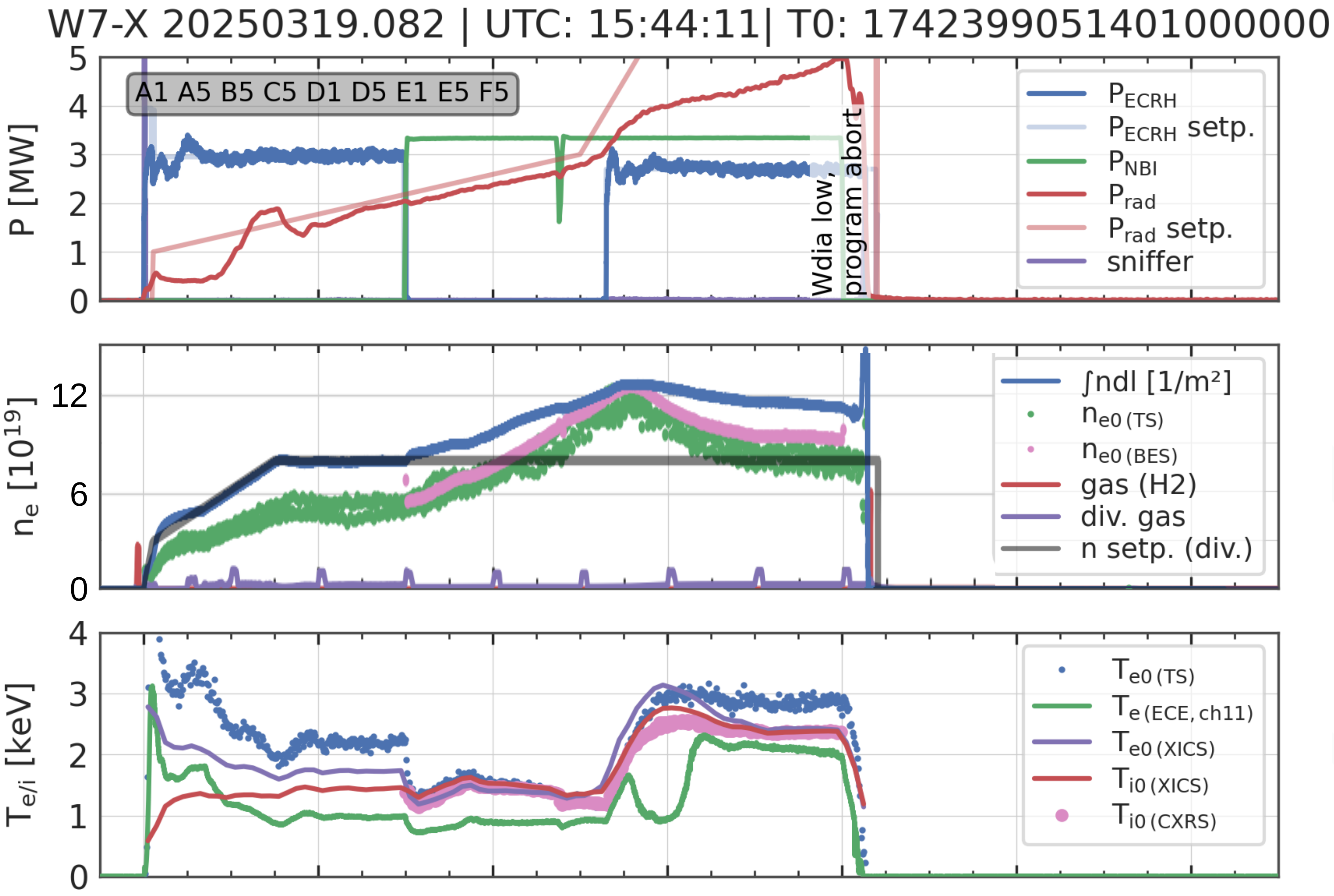
- NBI breakdowns during ramp-up change the initial density and change the required power.

- Seeding raises required ECRH power for same density control. Creates poor reproducibility so should be avoided, but may be needed for heat load mitigation.



Initial drop

- At ideal power, density often drops initially but stabilises and stay in reduced transport.



Candidate programs

- NBI + O2 reintroduction - reasonably reproducible. Lots of experience.
  - High-mirror: Lots of experience, poor max T_i = *1.8keV* - hard to tell if above normal.
  - **Standard: Good experience, reasonable max T_i = *2.5keV***
  - FMM002: Some experience, excellent max T_i = *3keV*, over W_{dia} > 1.5 MJ limit.
  - FTM: Little experience, excellent max T_i = *3keV* (probably).

- Pellet + NBI + O2 reintroduction
  - Less experience,
  +higher T_i,
  - poor reproducibility of start density
  + more time to see what feedback does.