Max-Planck-Institut für Plasmaphysik

# Session Planning
# OP2.3/SOII-14 : Max NBI+ECRH Power

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*TF-I Session Planning 24.02.2025*

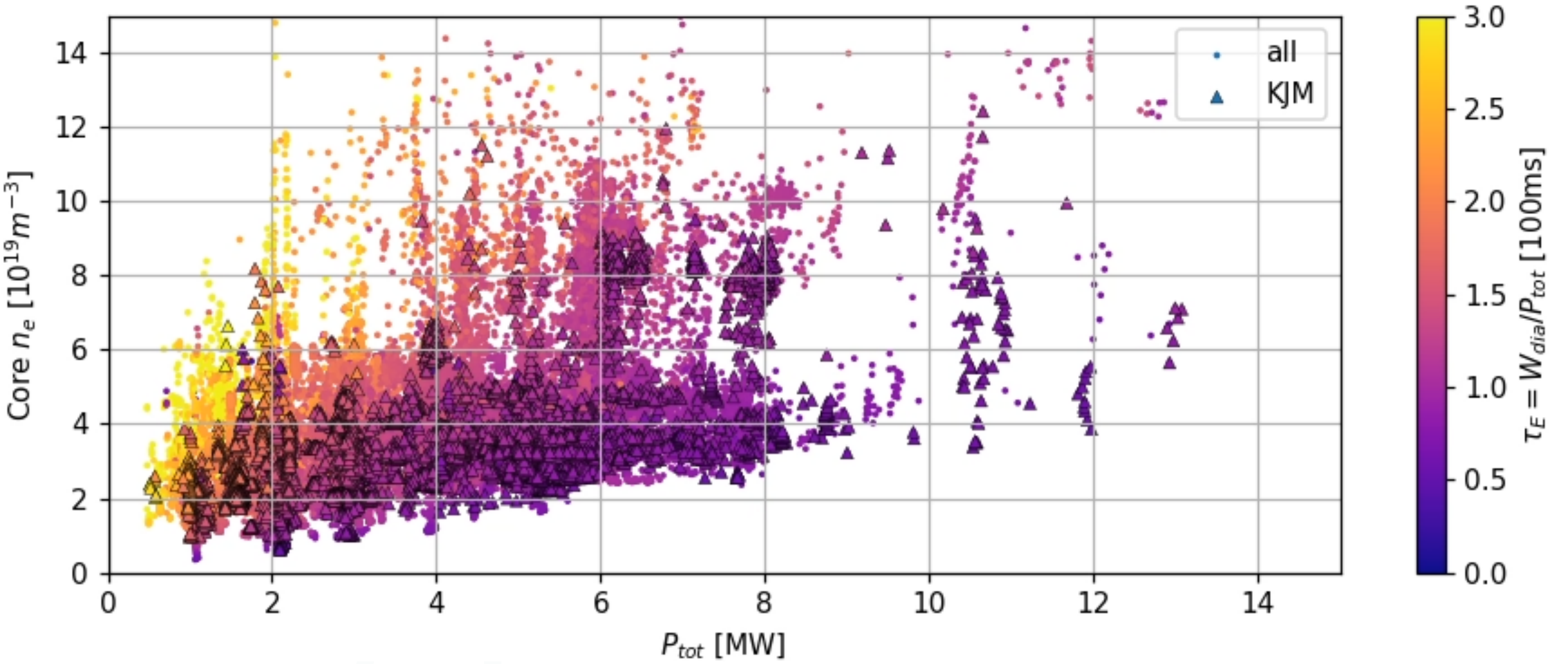
MAX PLANCK GESELLSCHAFT

EUROfusion

# Proposals

| **Prio 1:** | Title | Special Req. | Main gist |
|---|---|---|---|
| sul_037 *(T. Stange)* | High Power Discharges with NBI | | O2 ECRH @ ne=12, add 4x NBI |
| sul_062 *(T. Stange)* | Achievement of a maximum power discharge | | O2 ECRH, then add 4xNBI. Repeat in He. Add ICRH |
| anla_026 | Density Control and Seeding at Maximized Heating Power | | 4xNBI + P_ECRH = {6.0, 8.0, 8.5}. Ne = {12, 10, 8} |
| **Prio 2:** | | | |
| boz_042 | FI confinement in scenarios with AEs | | Make plasmas with AEs. |
| boz_051 | Effect of error fields on the distribution of fast-ion wall loads | | Normal ECRH, +NBI. Repeat with different TC, CC |
| sepo_001 | Ti and fast ion measurements with the 174 GHz CTS | CTS Gyrotron? | Medium ne, P_ECRH. Add NBI for fast ions. Scan CTS settings |
| npablant_021 | Transiently high nTtao through Ion Heating | | All ion heating to get max n.T.tau – done in 20241204.072 – over Wdia limit |
| sul_063 *(????)* | Assessing wall conditioning on fast ion confinement for CX validation | | Boron inj to get low ne. Run shots at 8e19 with NBI. Look at QHW |
| tere_004 | Zonal Flows using dual V-band Doppler Reflectometer | | Piggyback, change DR settings. |
| mzan_013 | MSE measurements at high betas | | High beta with ECRH+NI20. Blip NI21. |
| tya_033 | MHD-stability in high performance discharges | HP Scenario | High performance in every config |
| fwa_022 *(J. Zimmermann)* | Pulse Train exploitation | | Pulse trains. Changing ECRH settings |
| Keha_015 *(CP. Dhard)* | Wall conditioning by boron TESPEL and LBO | | Ref. Inject B/BN/B4C. Ref. Look at C, O and Zeff |

# Operational space



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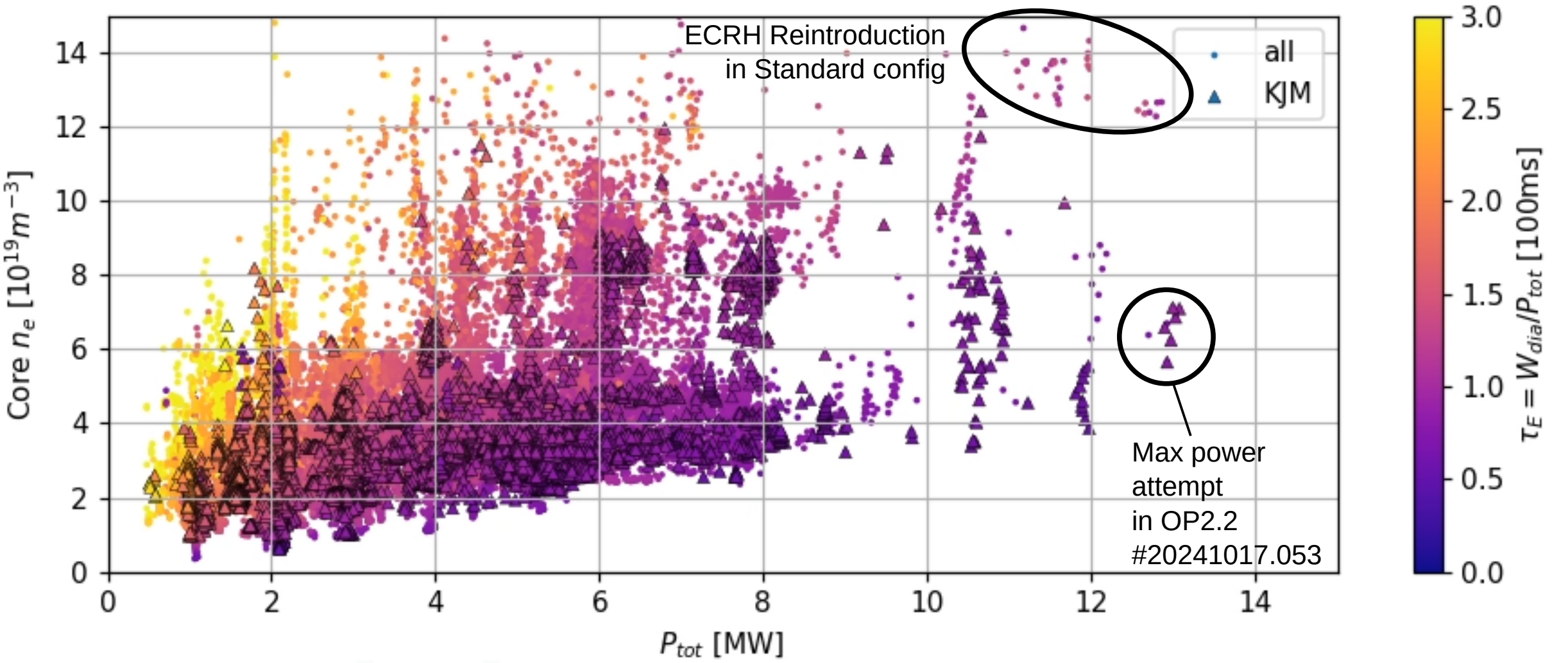

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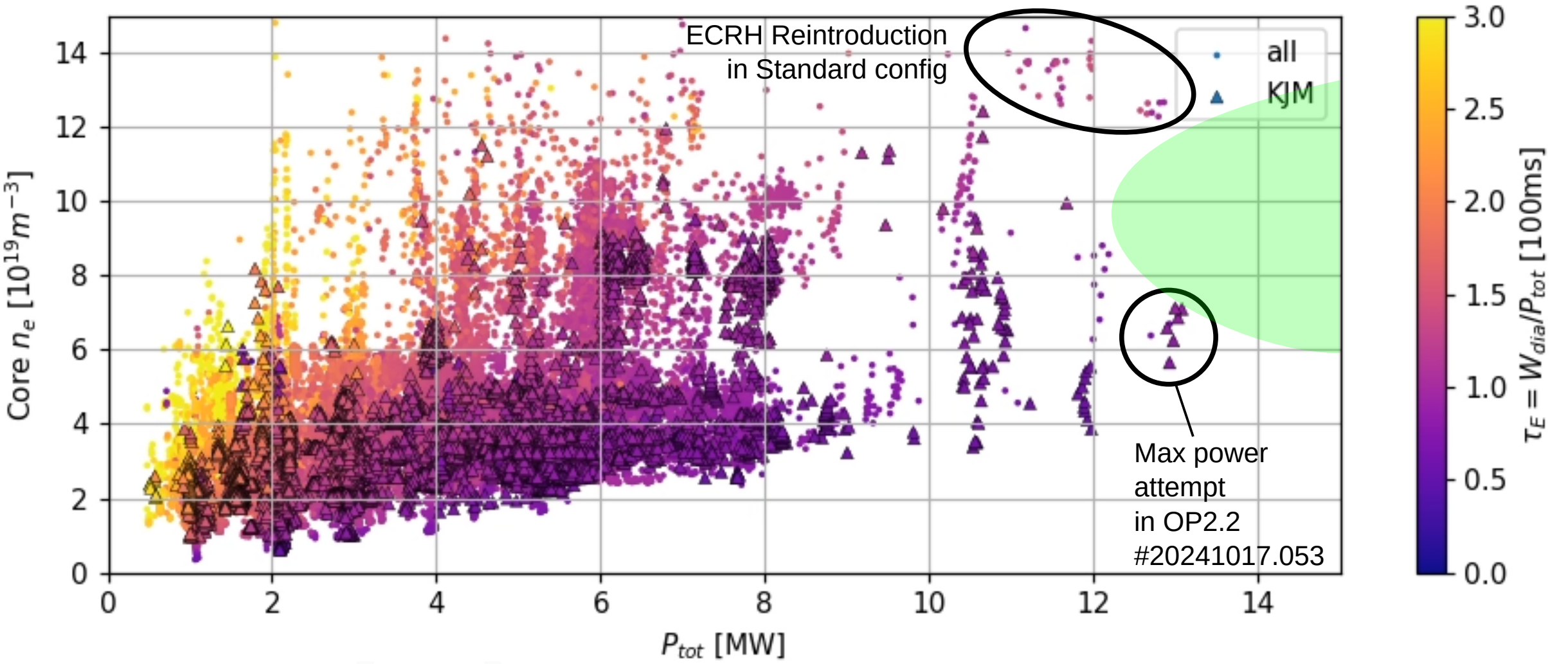


# Max $P_{ECRH}$ + $P_{NBI}$.

- Last attempt was only 1s (before power supply trip)
- No strong peaking --> $P_{ECRH}$ / $P_{NBI}$ is enough.
- Edge density rising (recycling).
  Will it stabilse?

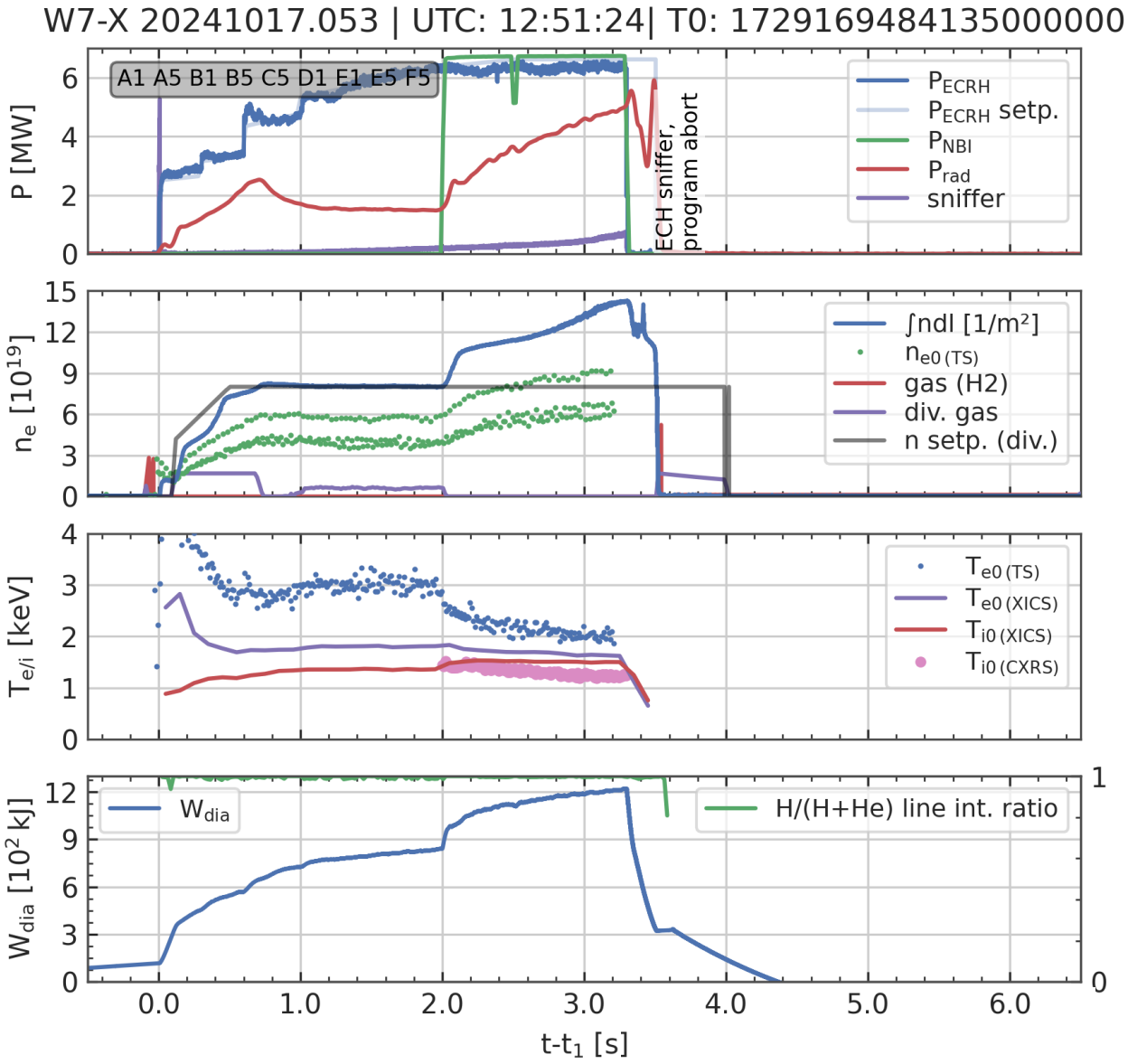
- More $P_{ECRH}$ is now possible (up to 8.5MW ??)

- Divertor heat loads will probably be a problem,
  particularly at this high $n_e$.
- Need seeding?

1) Rerun this out to 5s.
2) Raise to $P_{ECRH}$ = 8.5MW
3) Scan density (if controlled)

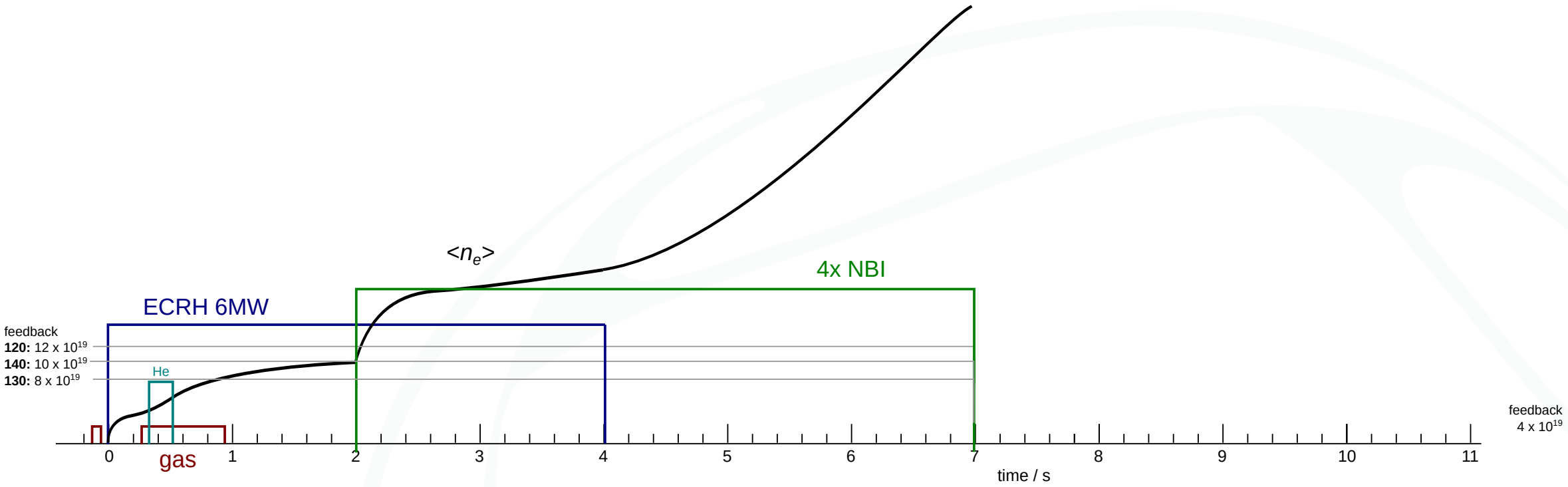
This covers sul_037, anla_026

- sul_062 requires this repeated in helium
  (Helium injection only 2 sources and not yet available)



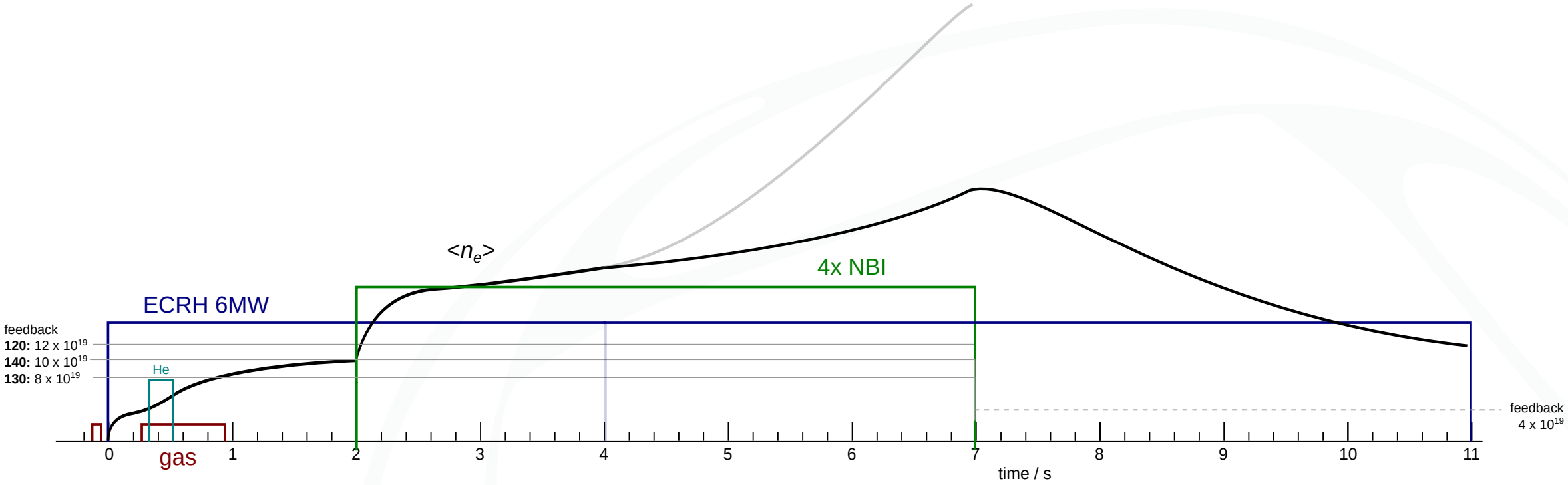
# Layout

- Previous attempt dropped the ECRH after 2s. ... why?



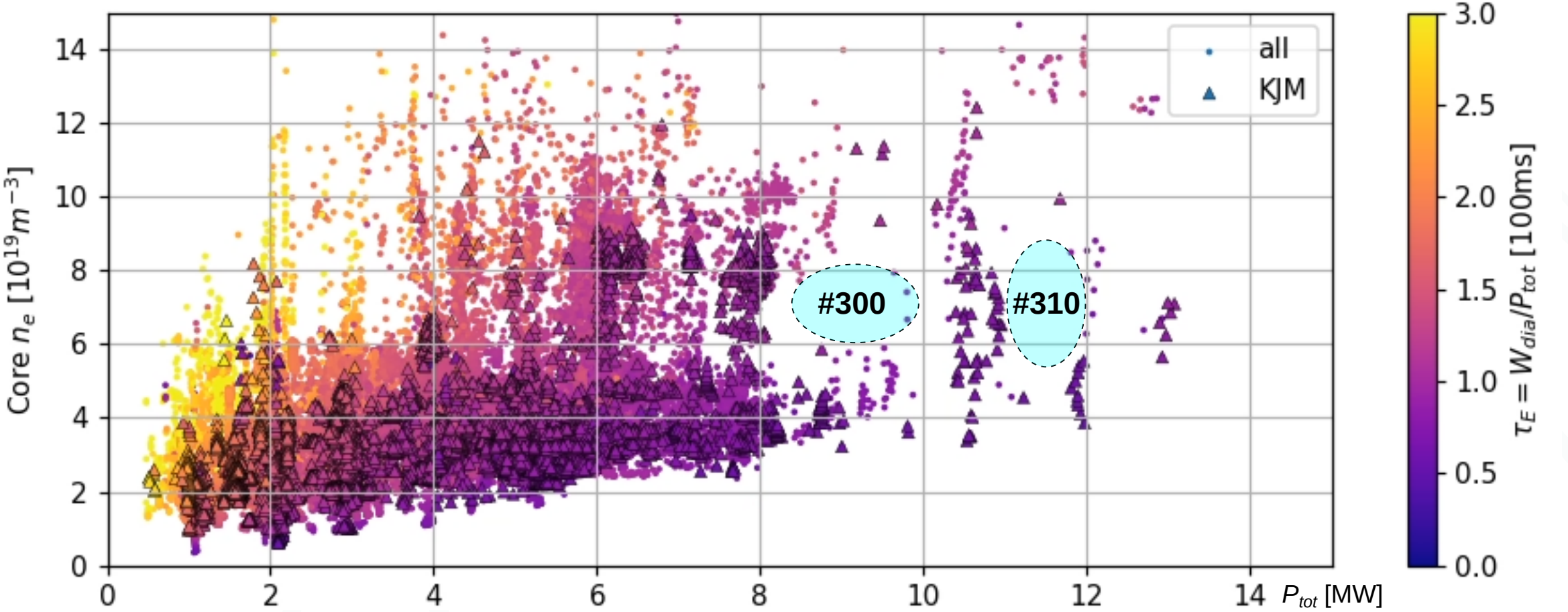
# Layout

- Previous attempt dropped the ECRH after 2s. ... why?
  Why not run out to 5s NBI and then even further to control wall condition?



# Operational space

With less NBI sources, we can fill in some gaps at moderate density and cover some prio2 proposals:
**#300:** S3,S4 + 5.5MW ECRH = 9MW. Blip S7+S8 for FIDA and MSE (mzan_013)
**#310+320:** 3 NBI sources + 6.25MW ECRH
**#350:** As 300, changing trim/control coils to affect fast ions (boz_051)



# Boron dropper

The boron dropper will be on the MPM. Two prio2 proposals require it:

keha_015 (C.P. Dhard) *"Wall conditioning by boron TESPEL and LBO"*

1) Reference.
2) Shot with Boron injection.
3) Reference.

If quick, we can fit in all 3 while waiting for NBI regerenation.

sul_063: *"Assessing wall conditioning on fast ion confinement for CX validation"*

1) Inject Boron to get low recycling.
2) Run NBI at low $n_e$.
3) Run NBI again with high $n_e$.

If keha_015 works, and the 3rd reference shows low recycling. We might repeat one NBI discharge.

My preference: Repeat the FI losses #350 and throw lots of boron in the middle.

but... this might conflict with seeded detachment, if it is being used.

Generally: We have lots time to wait for NBI, so between the pulse trains for fwa_022, the boron dropper people can continue the program from SOII-13, just in high mirror.

# Shots

Not many shots in plan, but 100 - 140 will take most/all of the session.

| ID | Desc | Sources | P_tot | ne | Config | From proposal | Also covers proposals | reference |
|---|---|---|---|---|---|---|---|---|
| 100 | 6MW ECRH + 4xNBI. Extend to 5s | 4 | 13 | 12 | KJM | anla_026 | | 20241017.053 |
| 110 | #100 with seeding feedback as necc. | 4 | 13 | 12 | KJM | sul_037, sul_062, anla_026 | | |
| 120 | 8.5MW ECRH + 4x NBI, 5s | 4 | 15.5 | 12 | KJM | sul_037, sul_062, anla_026 | | |
| 130 | 8.5MW ECRH + 4x NBI, 5s, lower ne | 4 | 15.5 | 8 | KJM | sul_037, sul_062, anla_026 | | |
| 140 | 8.5MW ECRH + 4x NBI, 5s, mid ne | 4 | 15.5 | 10 | KJM | | | |
| 300 | 2x NBI+ 5.5MW ECRH, ne(0) = 7e19. Blip S7/S8 for MSE+FIDA | 4 | 9 | 11.2 | KJM | mzan_013 | boz_051, pepo_.. | |
| 310 | 3x NBI + 6.25MW, ne(0) = 7e19. Blip other source for MSE+FIDA | 4 | 11.5 | 11.2 | KJM | mzan_013 | pepo_.. | |
| 320 | 3x NBI + 8MW. To match #100 with different e/i mix | | | | | | | |
| 350 | Repeat #300 with different error fields. (Blips only if both NI ready) | 2 / 4 | 9 | 11.2 | KJM | boz_051 | mzan_013, pepo_… | |
| 500 | Reference discharge for boron injection | | | | | keha_015 | | ? |
| 510 | Boron injection | | | | | keha_015 | | |
| 700 | Changing ECRH parameters during pulse trains | | | | KJM | fwa_022 | | |

# Core vs line integrated density

Conversion with only ECRH: LID ~ ne(0) * 1.6

With too much NBI/ECRH, $n_e(0)$ gets higher over time.