MAX-PLANCK-INSTITUT
FÜR PLASMAPHYSIK

S49: NBI+ECRH+Detachment in high-iota

Presented by Oliver Ford on behalf of the W7-X Team

TF-I Meeting. 17th February 2023

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Proposals

Prio-I:

oliford_002	Threshold of P_ECRH into pure NBI for heat transport change	NBI+ECRH physics
sul_035	Power steps of ECRH in NBI (LHD Comparison)	
sul_040	Mimick NBI divertor loads with ECRH	
jove_006	Effect of density peaking on fast-ion confinement	Measurements at high-beta
cak_023, 24, 25, 27, 29	Detachment using feedback div. gas. H, Ne fueling ...on Prad, NGM, div. neutral. pressure.	
daz_014	Detachment in NBI(+ECRH) discharges	Detachment
daz_015	Detachment optimization with recycling neutrals	

Prio-2:

cak_028, 30, glp_003	Detachment feedback on IR, machine learning, on div. bolometer
mkubk_003	Impurity concentration in detachment (PHA)
roblu_002 *(oliford_006)*	Boron injections in different configs
suk_041	Error field correction in high iota configuration

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Additional:

vape_003, mbeur_012	Detachment in NBI	Cover in passing
anla_021	Verification of residual ECCD for on-axis X2	TF request
boz_048	low-P, post B spontaneous density peaking in high-iota	SO discretion

NBI+ECRH scenario 1

Two main NBI+ECRH program types that show reduced turbulence:

1) Pure NBI density peaking - hit it with O2 ECRH.
  - Peak high beta, settles to ~stationary state with improved Ti.
  - Only short 1 - 1.5sec stable-ish period
      --> not enough time todo detachment studies
  - Possibility: try getting into detachment during discharge by density chasing the elevated set-point
  - Extra power of O2 ECRH will make this harder
  - Probably move ECRH to early after NBI start to
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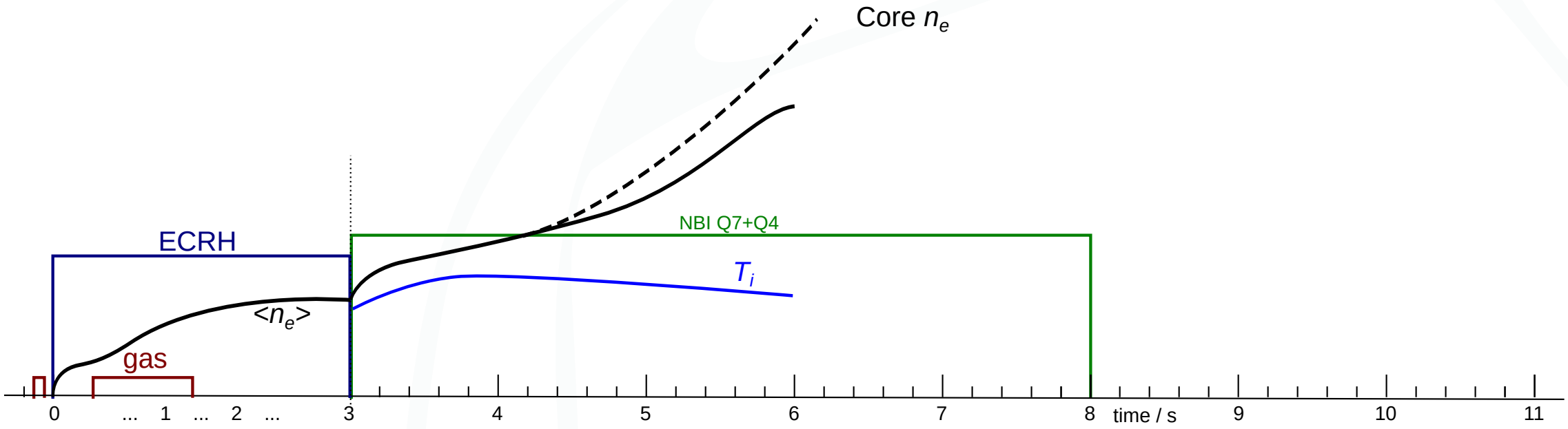

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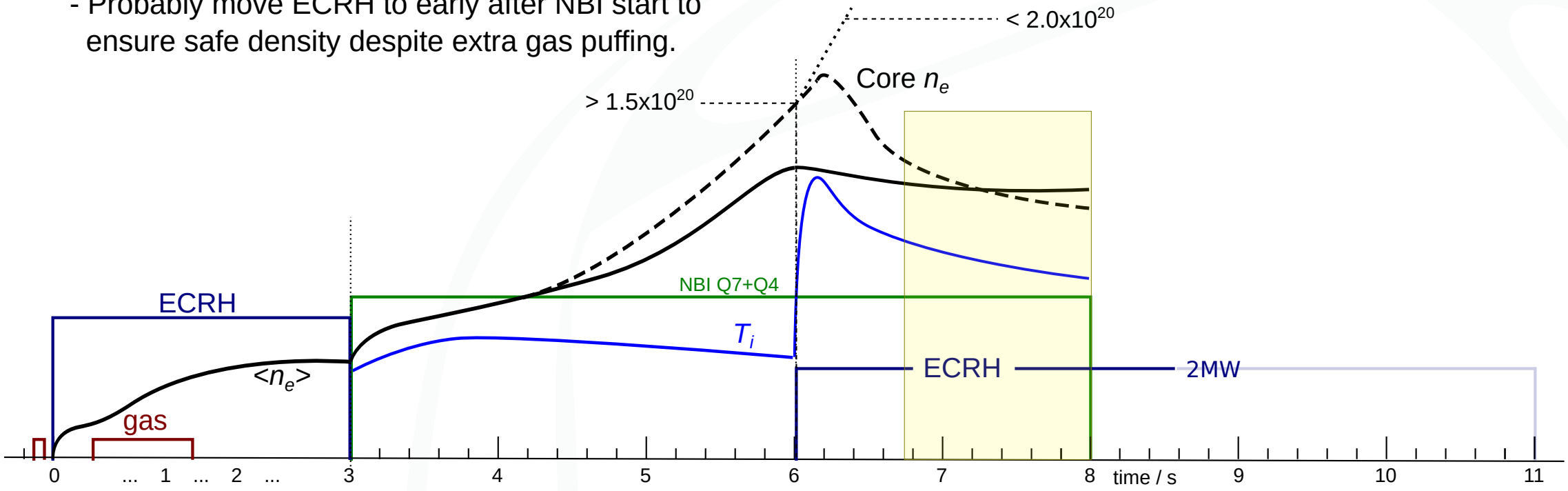

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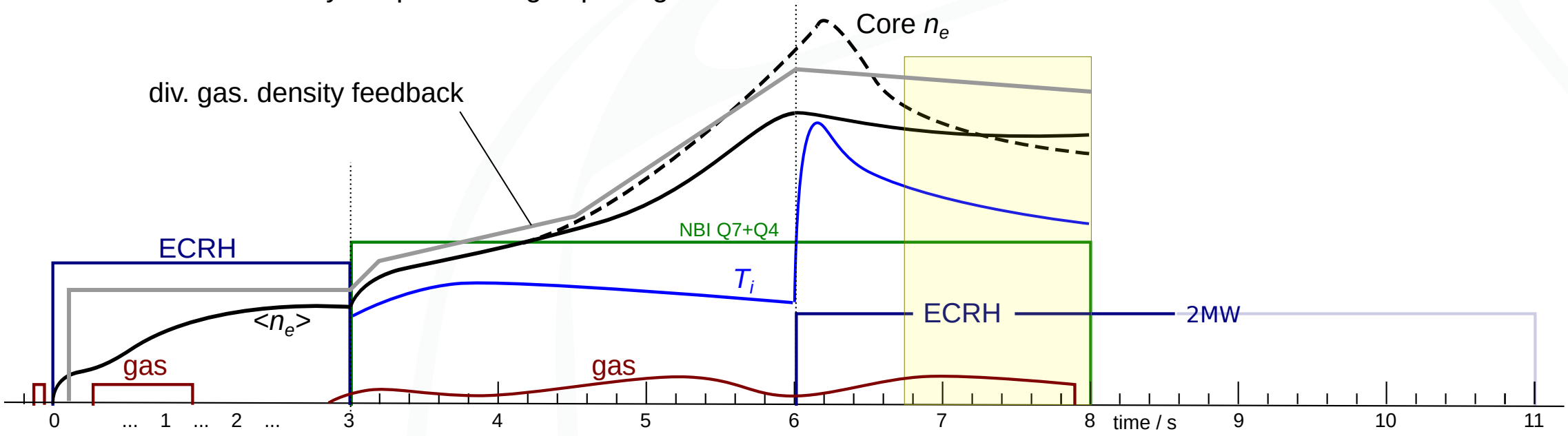
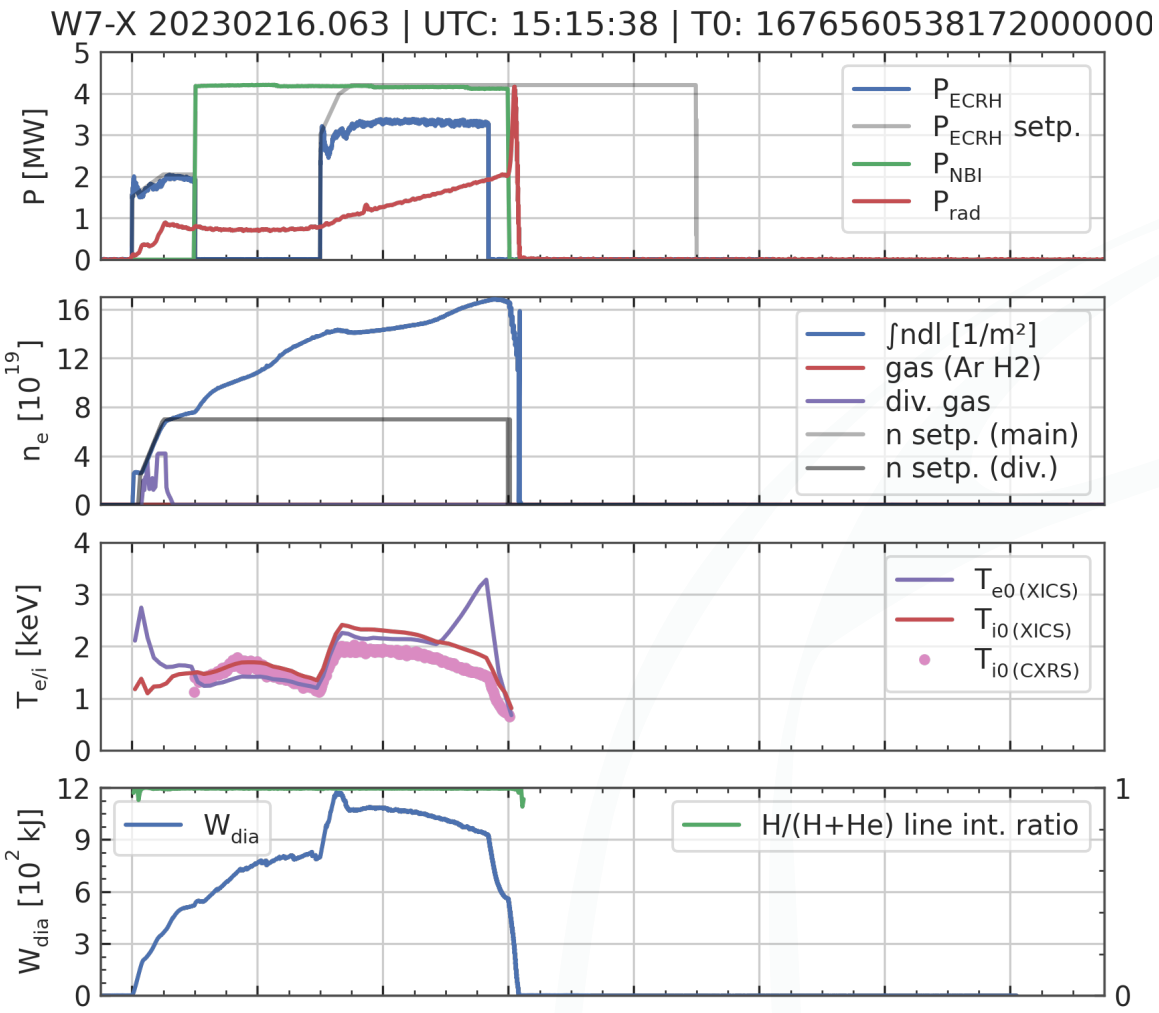
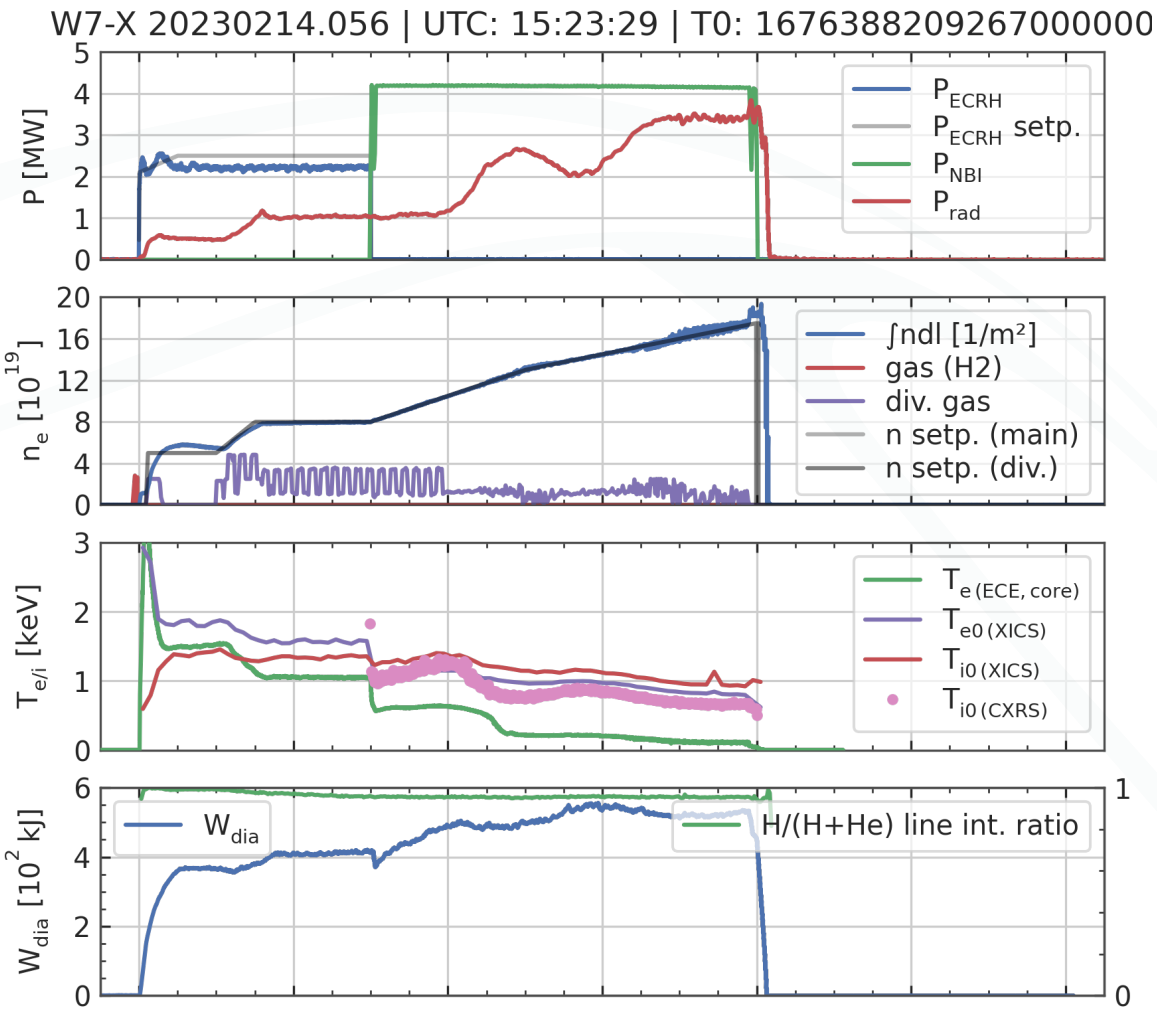


NBI+ECRH scenario 1

Combination of on-going development of NBI+O2 ECRH and pure NBI detachment (14.02.2023)

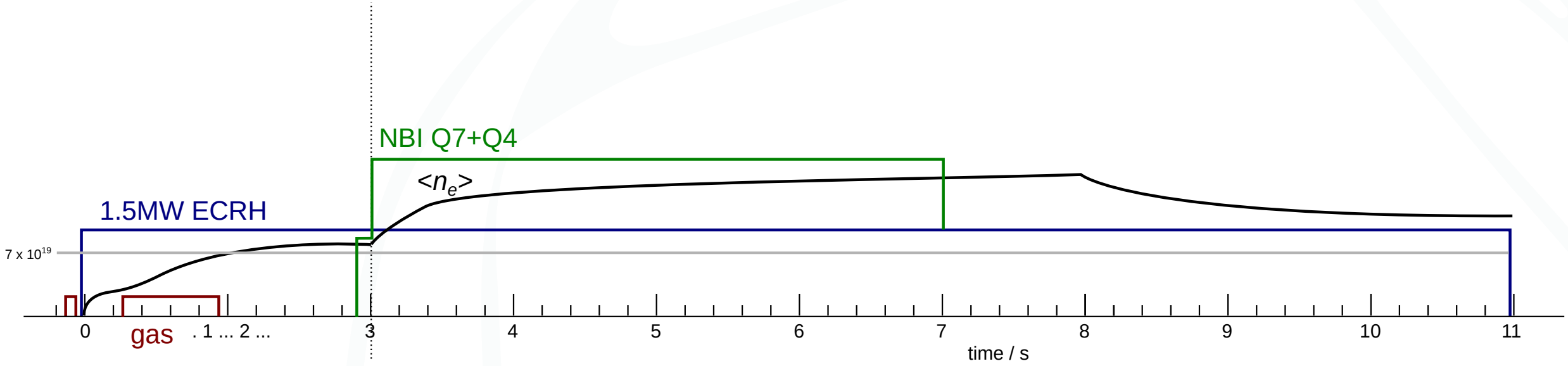




NBI+ECRH scenario 2 - Neon

We can enter reduce-turbulence steady-phase by adding NBI to low-ECRH.
- Much simpler with longer steady phase.
1) Use this for detachment from neon-seeding at normal density.

Is basically mbeur_012 from S38, but with high enough density and lower P_{ECRH} to definitely get density peaking and hopefully reduced turb.



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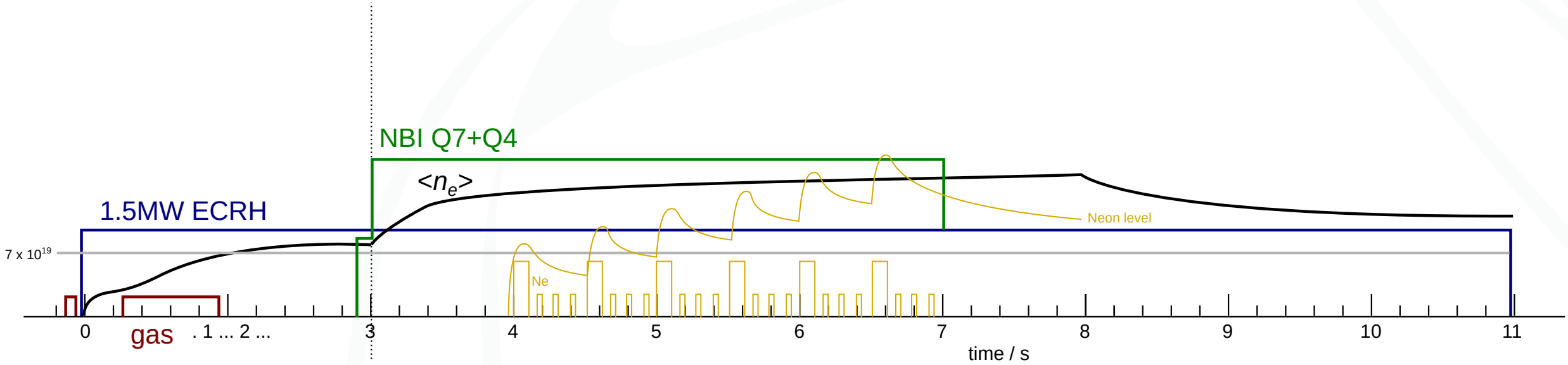

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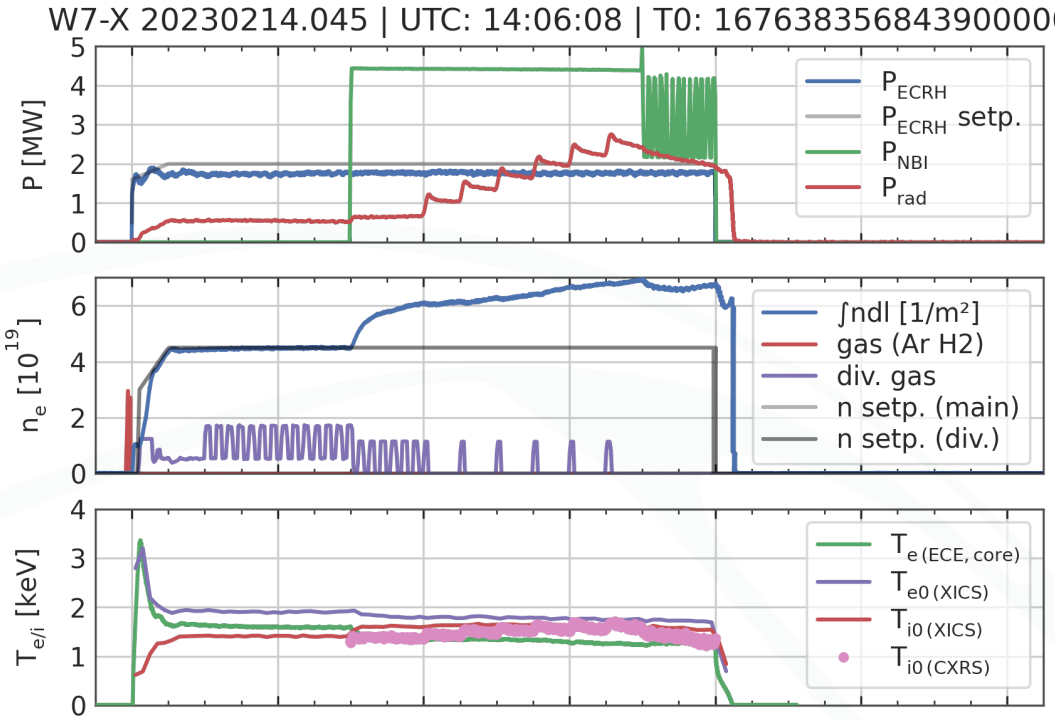
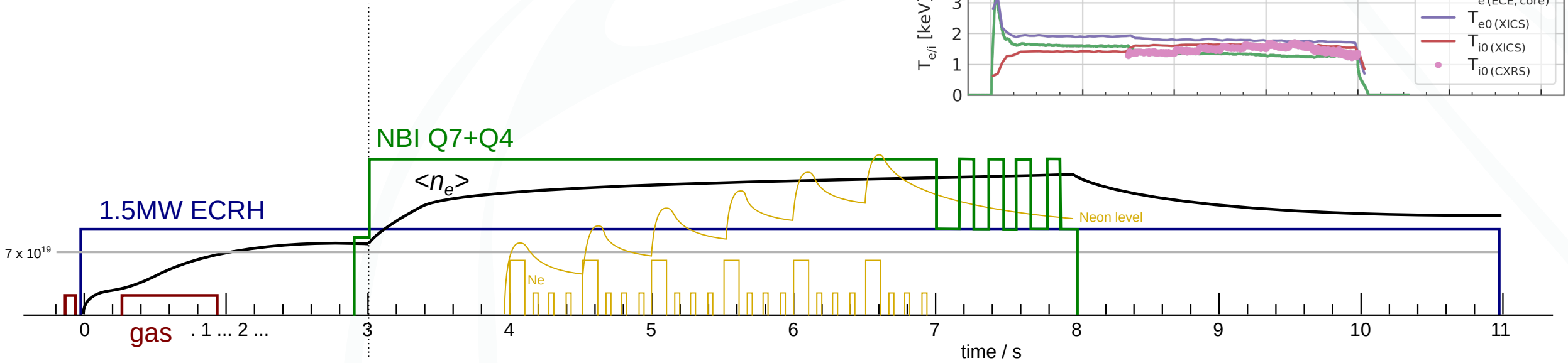
+Modulation of S7 (or 8) in place of S8 (or 7) for fast-ion measurements (for jove_006)





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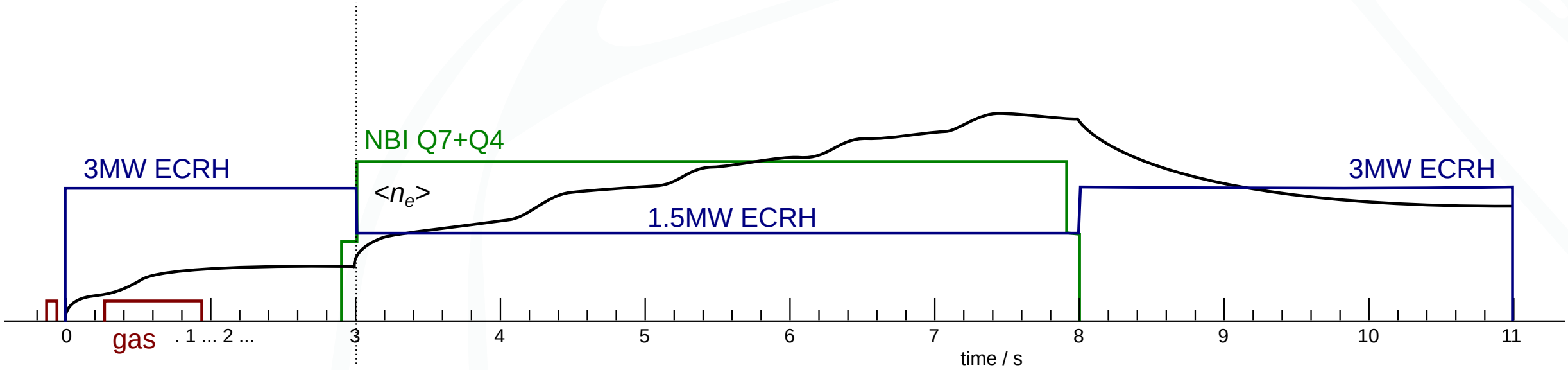

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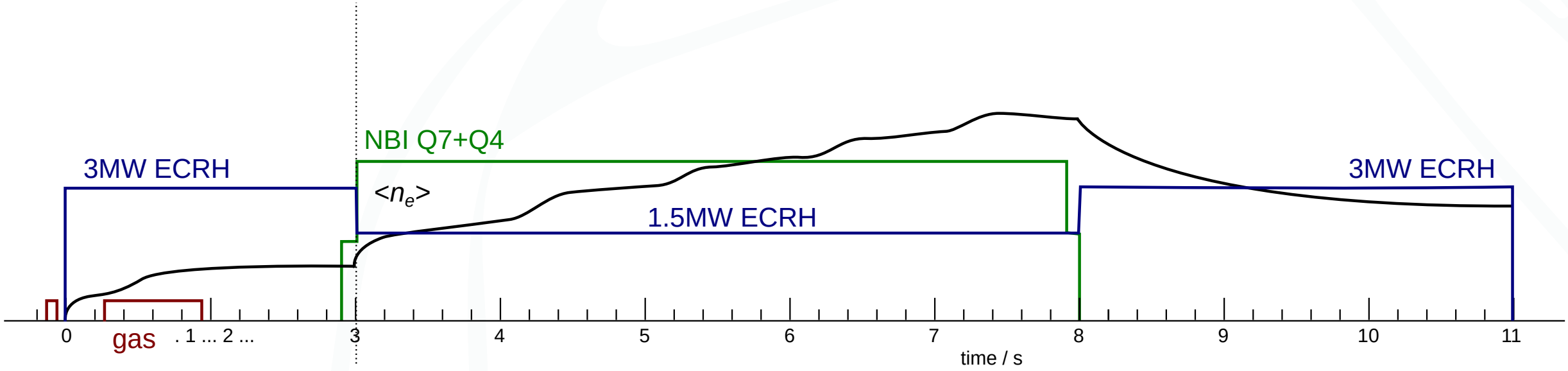

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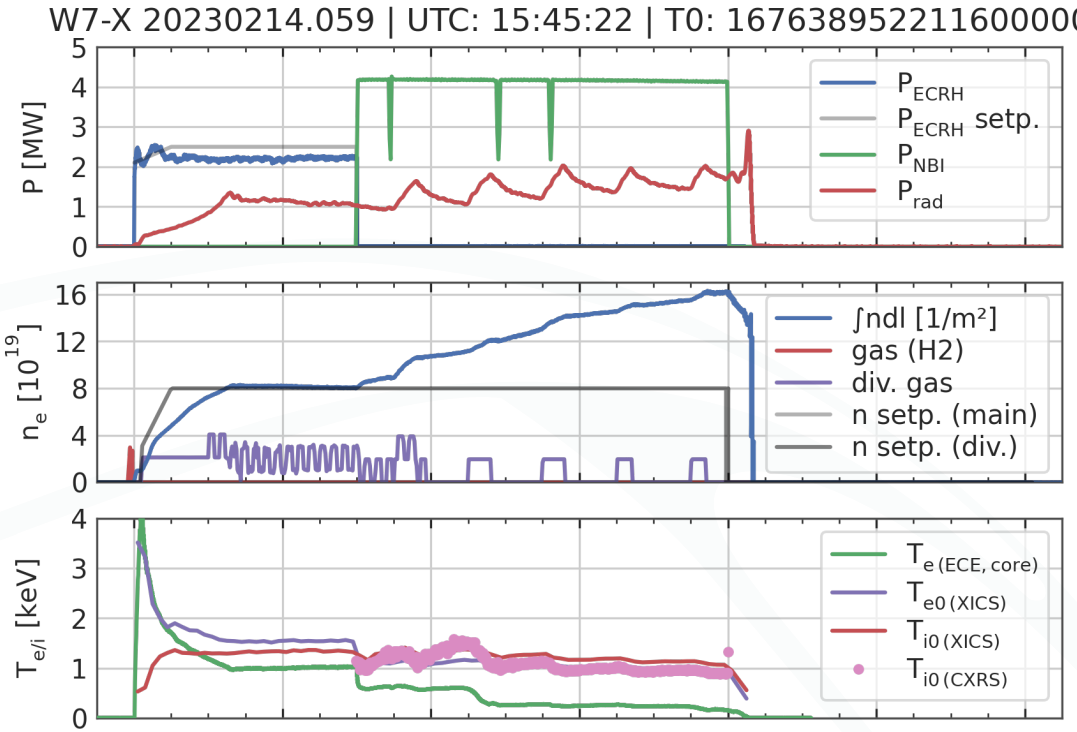

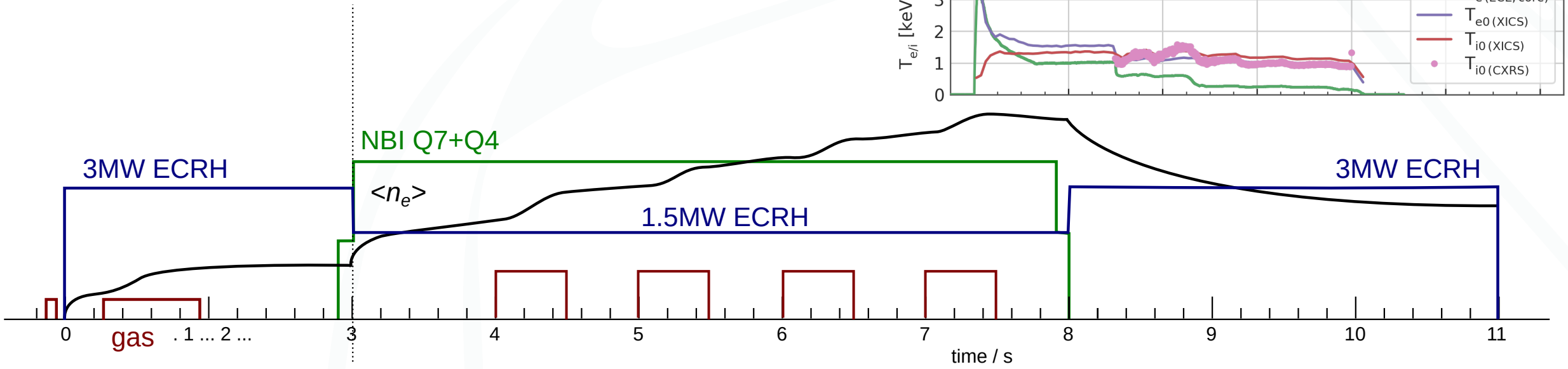

Shot list

ECRH program: Detachment, NBI strike-point matching

Safety | Scenario dev. | Diagnostic

#	e Description	References	ECRH	init ne	NBI	Diagnostic purturbation	Proposals
1	low P, post B spontaneous density peaking	#?	1MW			No	boz_048
2	Verification of residual ECCD for on-axis X2	#20230119.20				?	anla_021
3	Verification of residual ECCD for on-axis X2	#20230119.21				?	
4	NBI energy extension 0.5s					Outside NBI?	
5	Mimick NBI divertor loads with ECRH (+trim coils scan?)					?	sul_040, (+sul_041?)
6	NBI energy extension 1.0s					Outside NBI?	
7	Mimick NBI divertor loads with ECRH (+trim coils scan?)					?	sul_040, (+sul_041?)
8	NBI energy extension 5.0s, safety+comparison					No	
9	Mimick NBI divertor loads with ECRH (+trim coils scan?)					?	sul_040, (+sul_041?)
10	NBI + reintroduce O2, best of S42 repeat, (no gas)		3 MW		8.5 Q7+Q4	No	oliford_002, jove_006, sul_035
11	Mimick NBI divertor loads with ECRH (+trim coils scan?)						sul_040
12	NBI + reintroduce O2, H fueling for detachment, (chasing setpoint)	#20230214.056, #20230216.63, S42	3 MW		8.5 Q7+Q4	No	cak_024, daz_014, +vape_003
13	Detachment preparation					?	daz_015, cak_024, +vape_003
14	Constant NBI+ECRH, Ne for detachment	#20231207.054	1-3MW		Q7+Q4	?	daz_014, sul_035, oliford_002, cak_024, jove_006, +mbeur_012
15	Detachment preparation					?	daz_015, cak_024
16	Constant NBI+ECRH, Ne for detachment	#20231207.054	1-3MW		Q7+Q4	?	daz_014, sul_035, oliford_002, cak_024, jove_006, +mbeur_012
17	Detachment preparation					?	daz_015, cak_024
18	Constant NBI+ECRH, H detachment	#20231207.054	1-3MW		8 Q7+Q4	?	daz_014, sul_035, oliford_002, cak_024, jove_006, +mbeur_012
19	Boron injection					?	roblu_002
20	Constant NBI+ECRH, H detachment	#20231207.054	1-3MW		8 Q7+Q4	?	daz_014, sul_035, oliford_002, cak_024, jove_006, +mbeur_012
21	Boron injection					?	roblu_002
22	Constant NBI+ECRH + Boron dropper (no detachment)	#20231207.054	3 MW		8 Q7+Q4	?	roblu_002, +oliford_006