Field scaling of electron transport change with heating power

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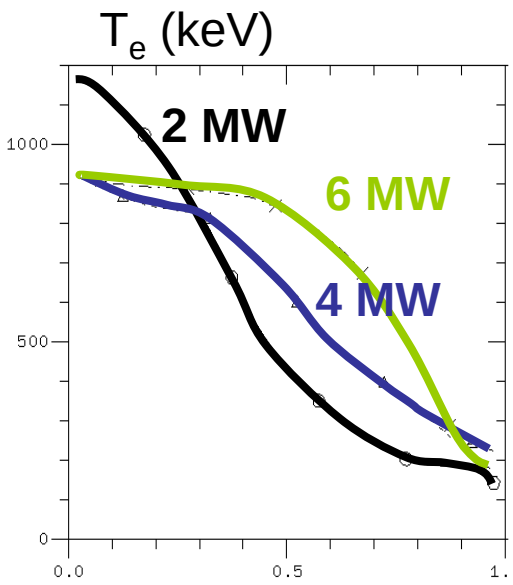
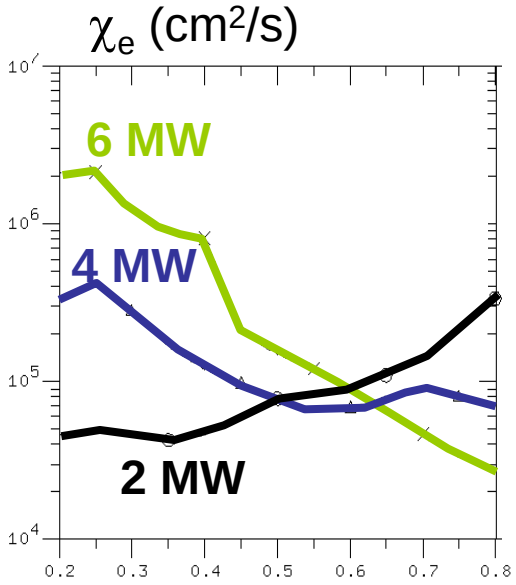
PPPL

Unusual T_e broadening with P_{NB} in NSTX H-modes

1 MA, 4.5 kG, early heating, small-ELM H-mode, t=0.425 s

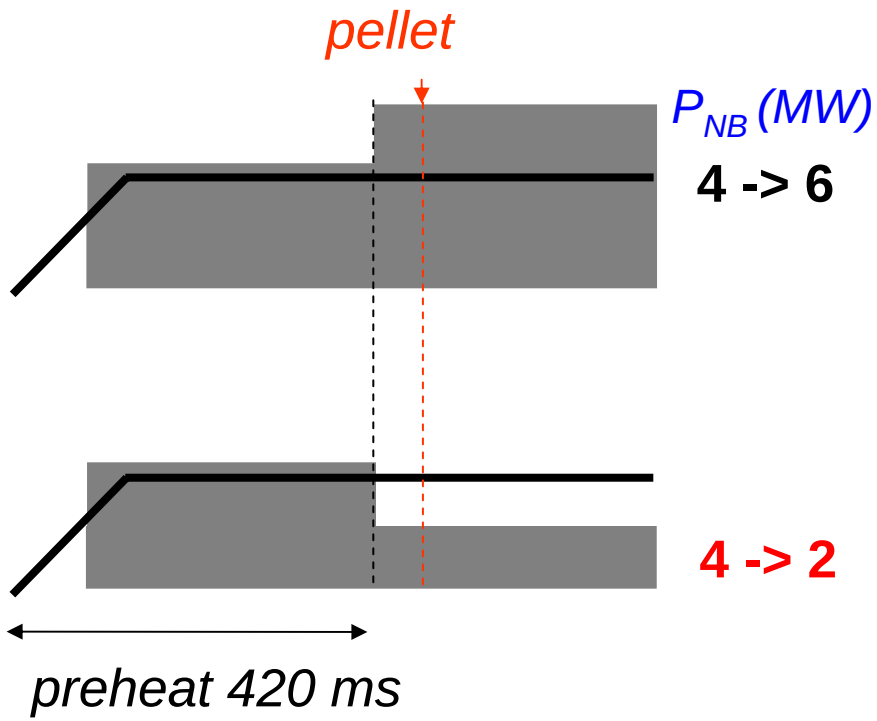


r/a



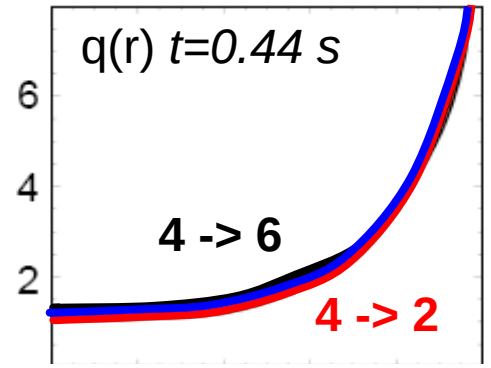
- **Caused by large increase in central χ_e with P_{NB}; ions stay neoclassical**
- **Genuine electron transport effect:**
  - **large χ_e at high P_{NB} supported by perturbative experiments**
  - **not caused by MHD induced fast ion redistribution (faint MHD, TRANSP matches neutrons, little effect on χ_e even if ions redistributed)**
- **q, ω_{ExB} generally also change with P_{NB}**

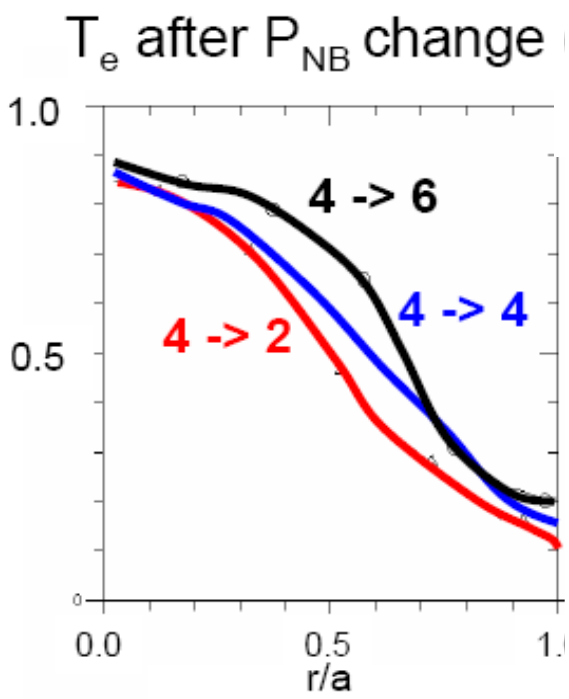
Recipe for varying P_{NB} at fixed q, ω_{ExB} developed in XP612

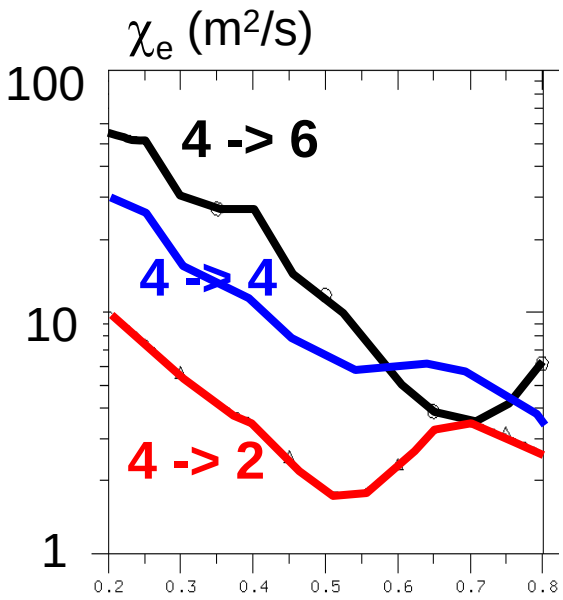


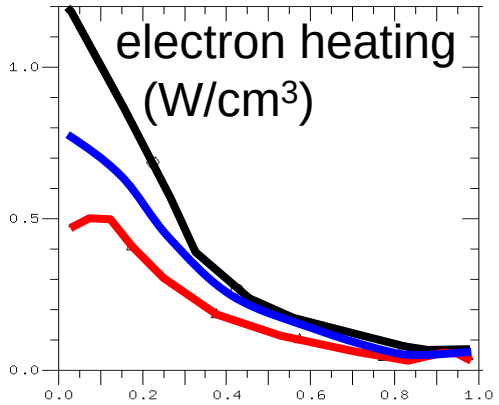
- **Preheat to 'freeze-in' q-profile -> step P_{NB}, also inject Li pellet**

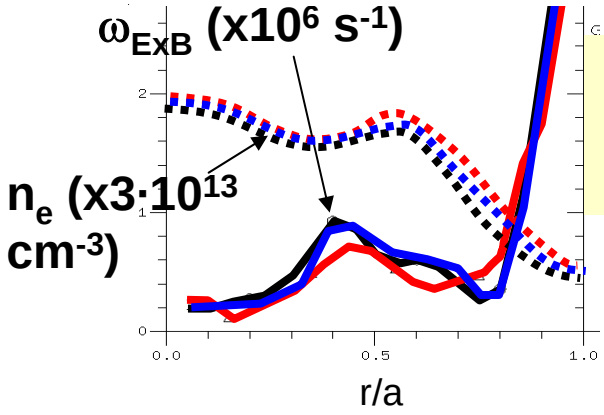
Large change in electron heating at fixed q, ω_{EXB} possible







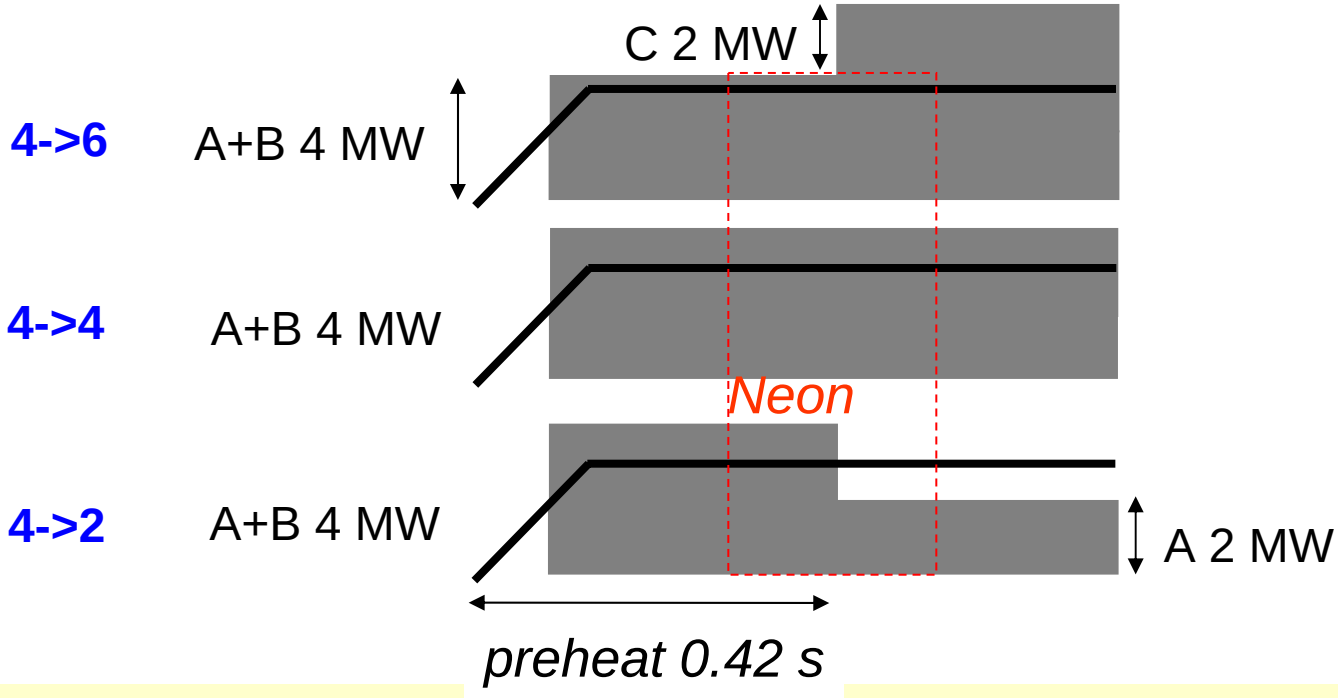




- **Increase in electron heating degrades χ_e**

  Does χ_e degrade less at high B_t ?

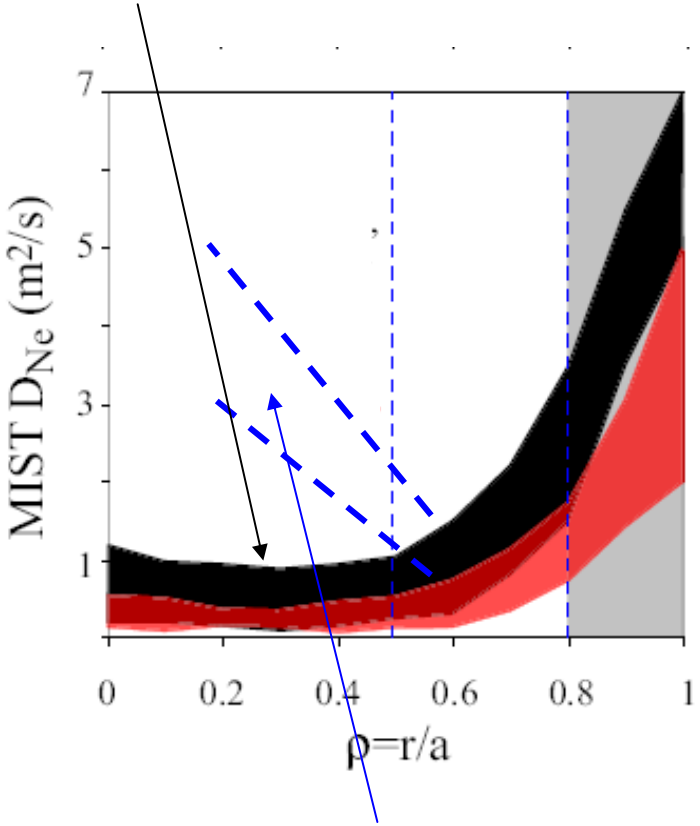
XP822: χ_e degradation with P_{NB} as a function of B_t

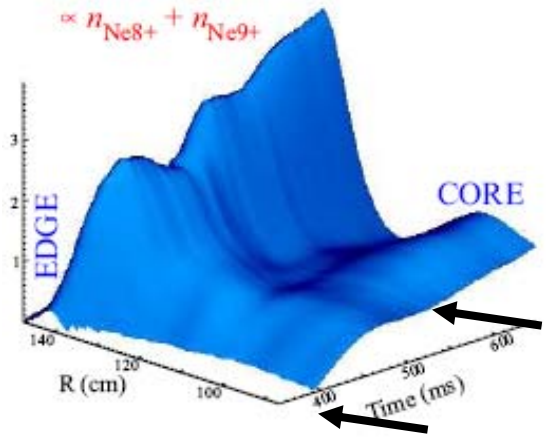


- **Use recipe from XP 612 to change electron heating at fixed q, n_e, ω_{ExB}**
- **Step P_{NB} at different B_t and fixed I_p/B_t:**
  - **0.45 T / 0.9 MA: 4->6, 4->4, 4->2**
  - **0.55 T / 1.1 MA: 4->6, 4->4, 4->2**
  - **0.36 T / 0.7 MA: 4->6, 4->4, 4->2**
- **Correlate transport changes with changes in high-k scattering (*r/a ~ 0.2*)**
- **Inject Neon to document eventual particle diffusivity changes**

Does central particle diffusivity also degrade with P_{NB}?

4 MW H-mode (L. Delgado EPS 07)





P_{NB} step

Neon puff 50 ms

6 MW H-mode (D. Stutman EPS 06)

- **Inject Ne early, look for change in impurity influx after P_{NB} step**

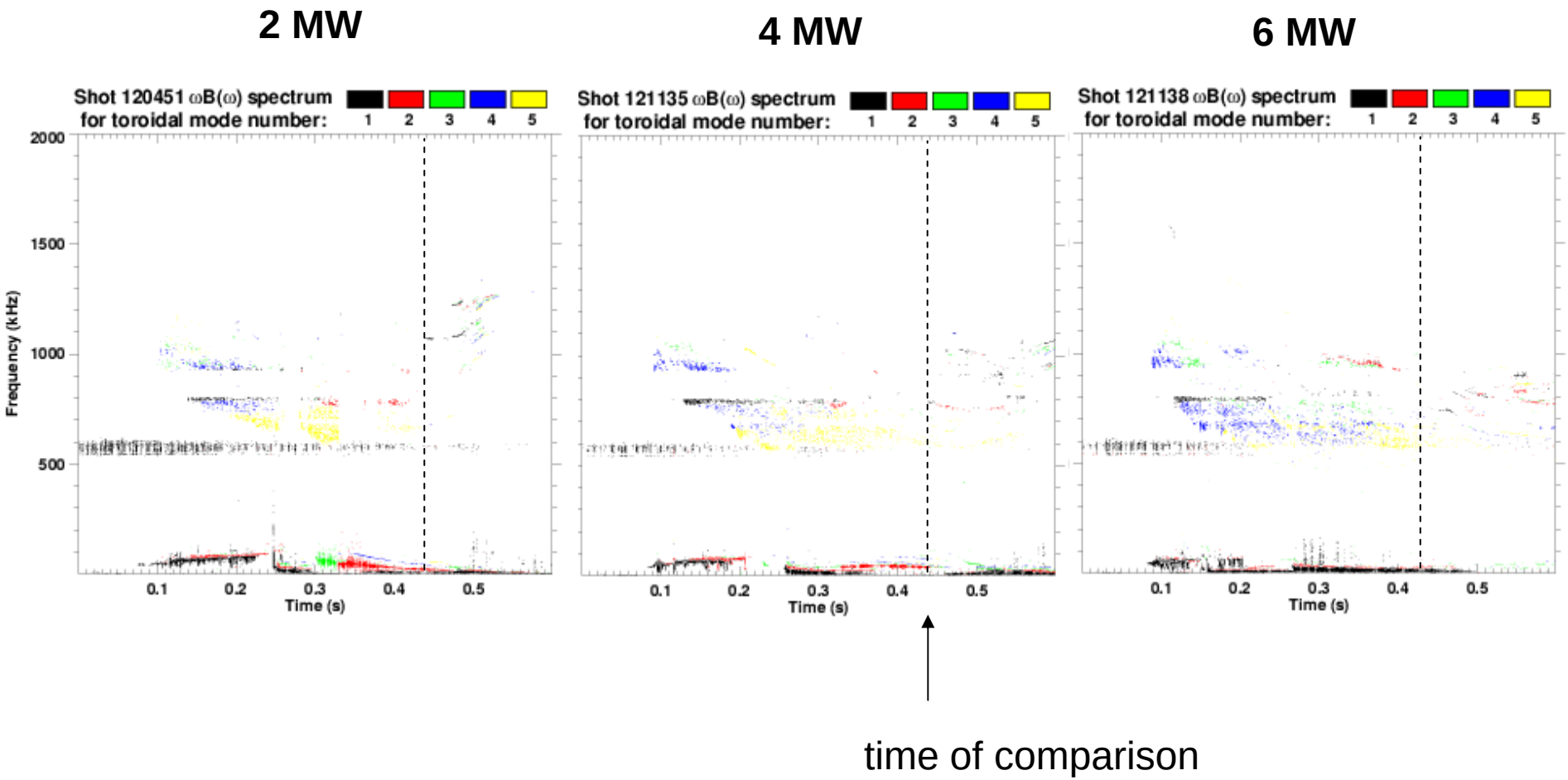
		P_{NB}		#shots
B_t / I_p				
4.5/0.9	**4->4**	**4->6**	**4->2**	2x3
3.6/0.7	**4->4**	**4->6**	**4->2**	2x3
5.5/1.1	**4->4**	**4->6**	**4->2**	2x3
		Neon		
5.5/1.1	**4->4**	**4->6**	**4->2**	1x3

21 shots

- **Baseline discharges 121135 (small ELM DND, 4.5 kG, 1 MA, κ~2.25, δ~0.6), and 121172 (5.5 kG, 1.2 MA)**
- **Possibly controlled access to change high-k to r/a~0.65**

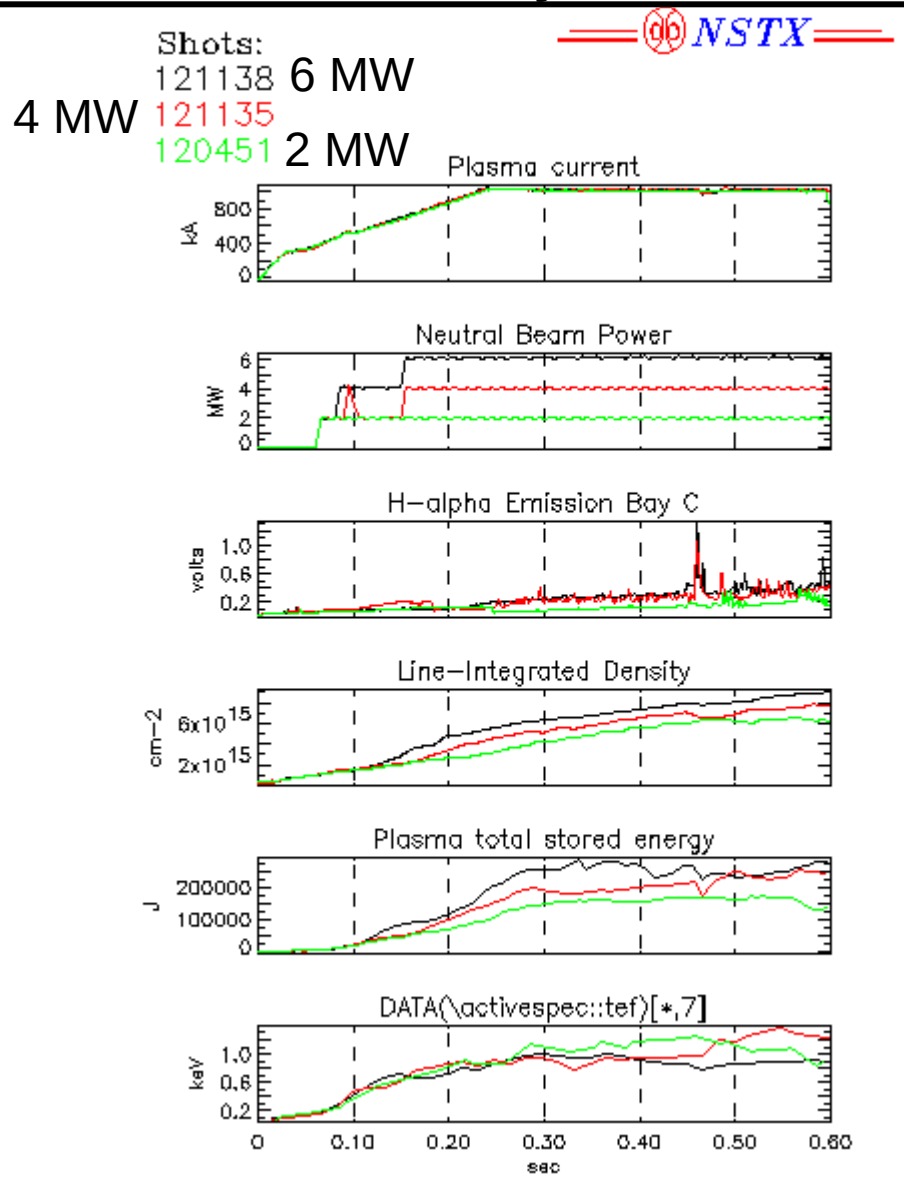
Backup slides

Mild core MHD, comparable amplitude at all P_{NB}

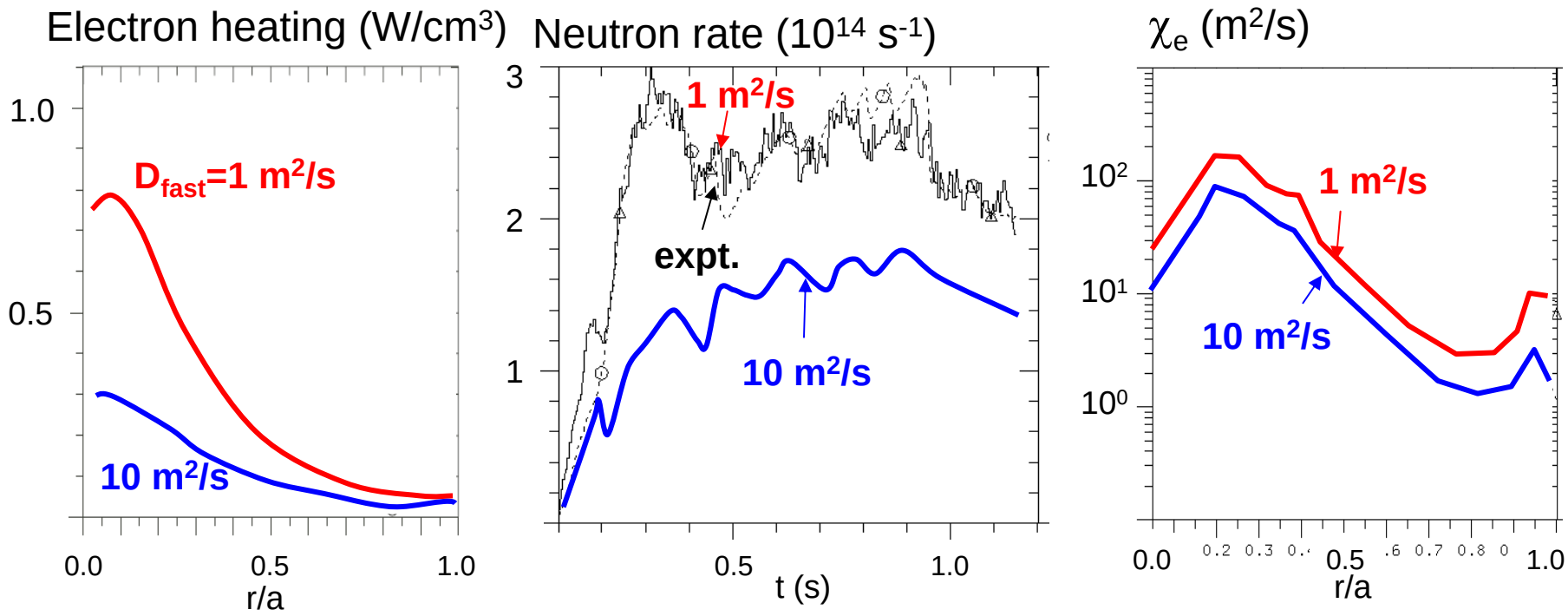


- **T_e flattening appears genuine electron transport effect**

ELM activity also mild



Analysis indicates power balance correct



- **Fast ion diffusivity increased in TRANSP to study effects of fast ion redistribution**
- **Order of magnitude increase in D_{fast} does not change χ_e much, while neutron rate decreases well below experiment**
- **Conclusion holds even when D_{fast} increase limited to r/a < 0.5**