Field scaling of electron transport change with heating power

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Decision issue for Transport group

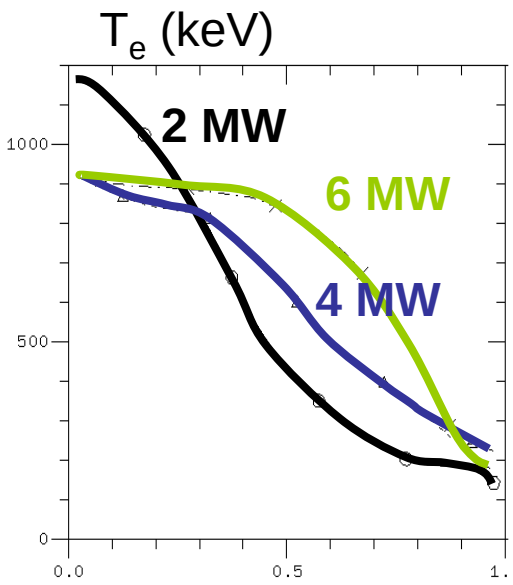
- **Similar XP (without NPA scan) was Team reviewed last year and a NPA scan requested in order to validate TRANP power balance (i.e. make sure Te broadening not due to fast ion MHD redistribution)**

- **Transport group MUST decide (and DEFEND its decision in front of the Team) whether a NPA scan is necessary in order to finalize this experiment**

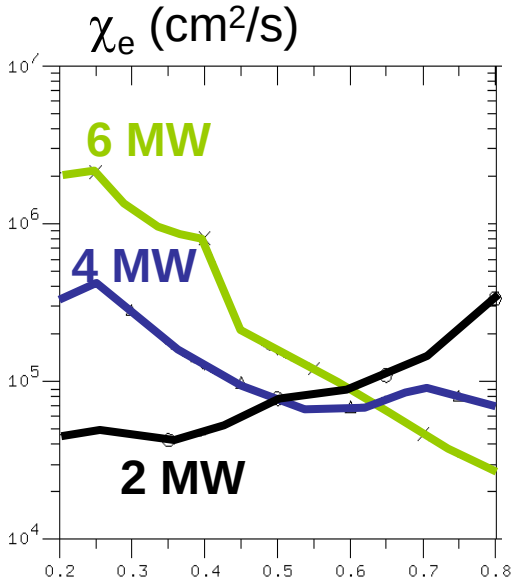
- **If yes, time for validating TRANSP should be charged to cross-cutting work**

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

1 MA, 4.5 kG, early heating, small-ELM H-mode, t=0.4 s

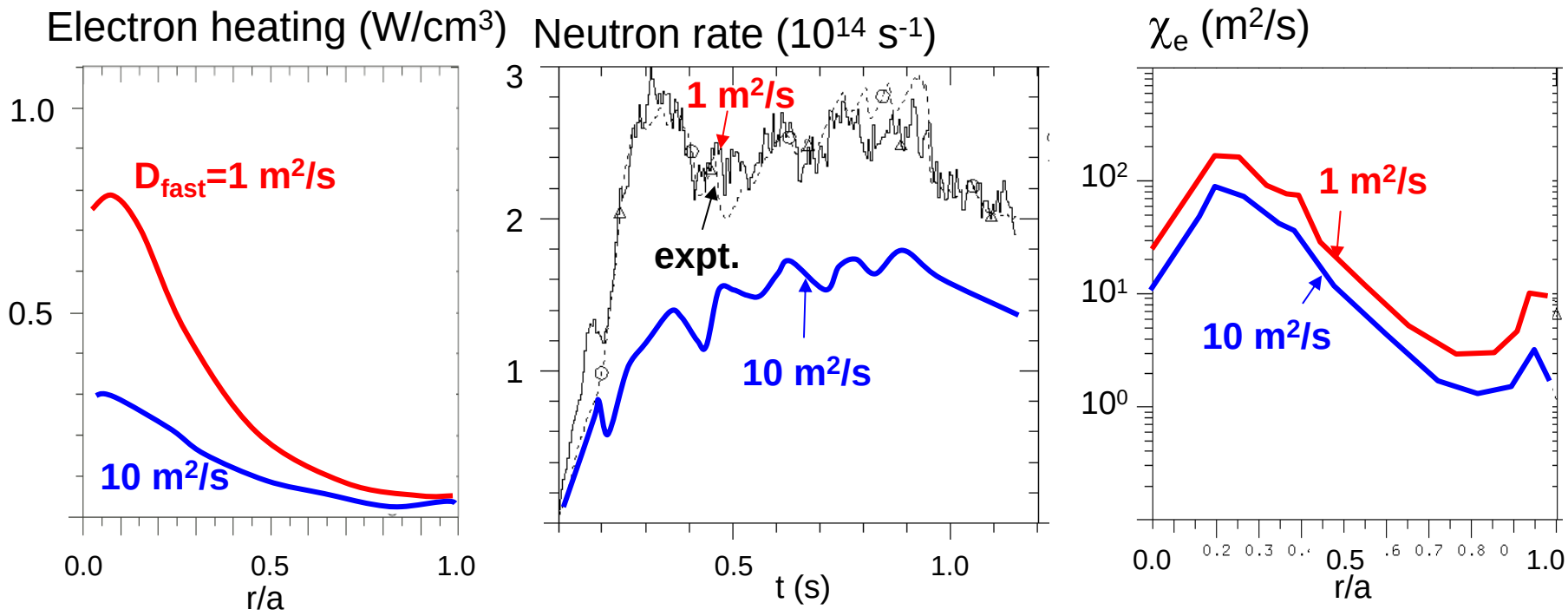


r/a



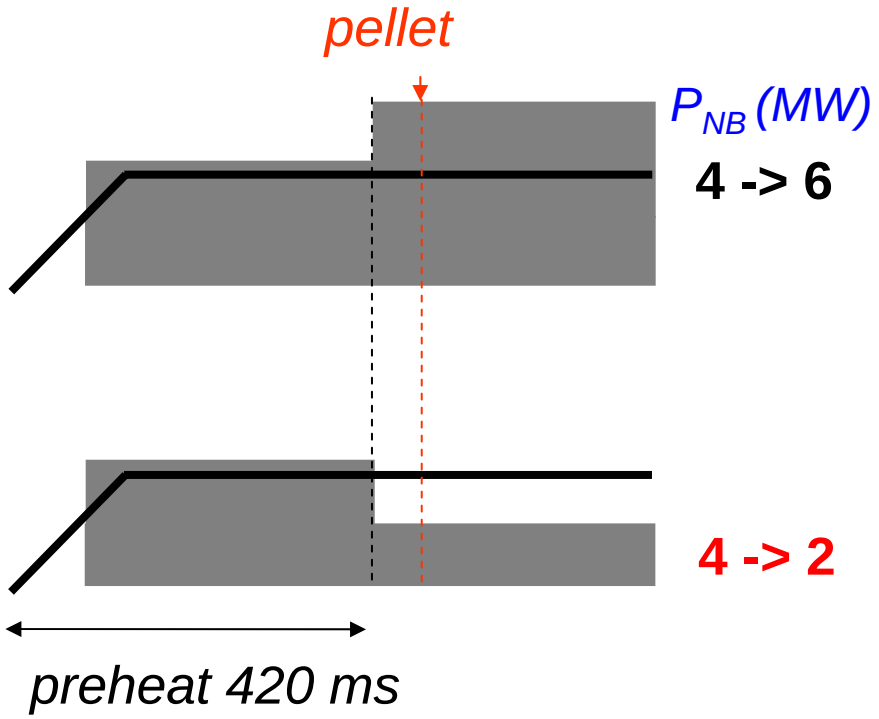
- **Caused by large increase in central χ_e at high power, decrease outside**
- **Believed genuine electron effect:**
  - **large χ_e at high P_{NB} confirmed in perturbative experiments**
  - **energetic ion redistribution unlikely ($S_n^{TRANSP} \sim S_n^{exp}$), no low-n MHD**
  - **ion transport stays around neoclassical**

Analysis indicates power balance correct



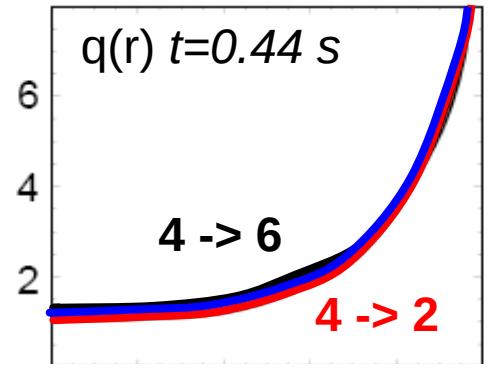
- **Fast ion diffusivity increased in TRANSP to study effects of fast ion redistribution**
- **Order of magnitude increase in D_{fast} does not change χ_e much, while neutron rate decreases well below experiment**
- **Conclusion holds even when D_{fast} increase limited to r/a < 0.5**

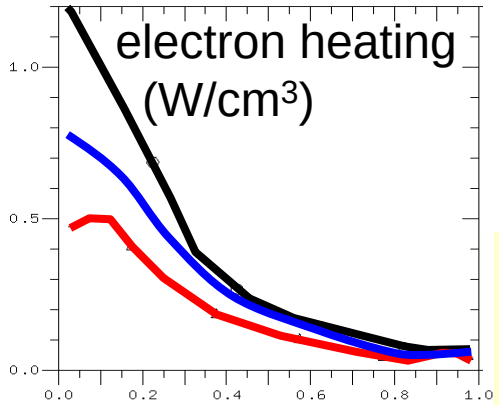
P_{NB} varied at fixed-q in XP612

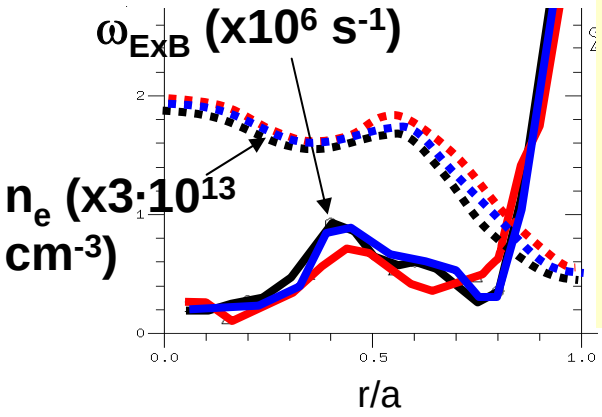


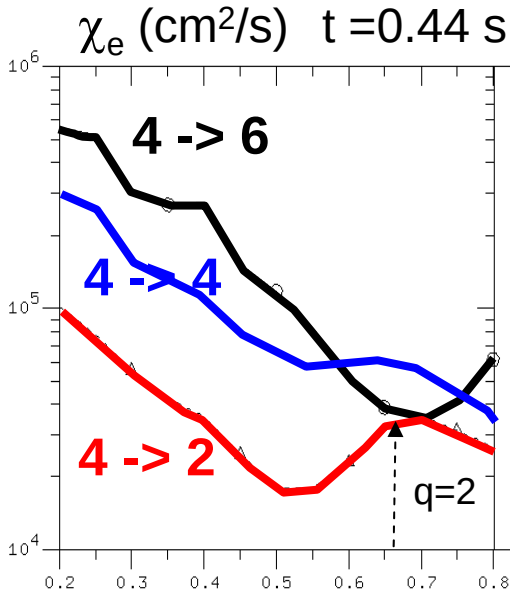
- **Preheat to 'freeze-in' q-profile -> step P_{NB}, inject Li pellet**
- **Conclusions based on both P_{NB} steps and pellet perturbations**

Change in electron heating strongly changes χ_e





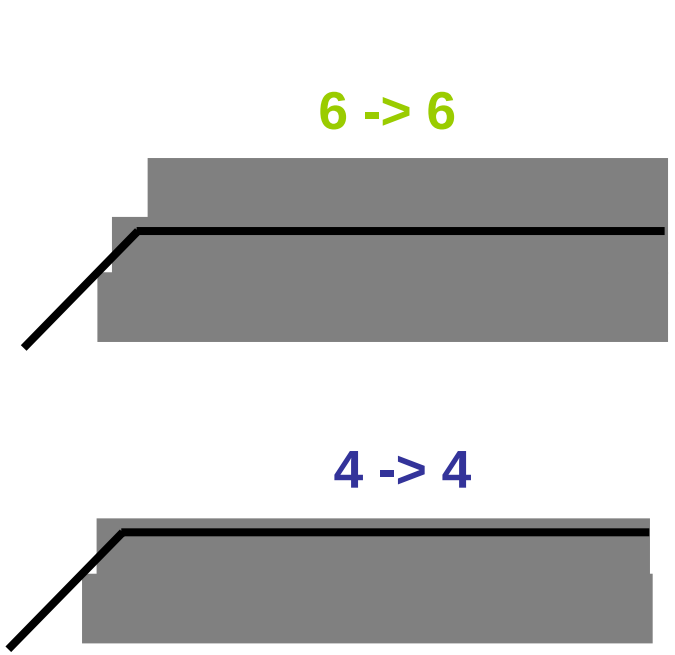


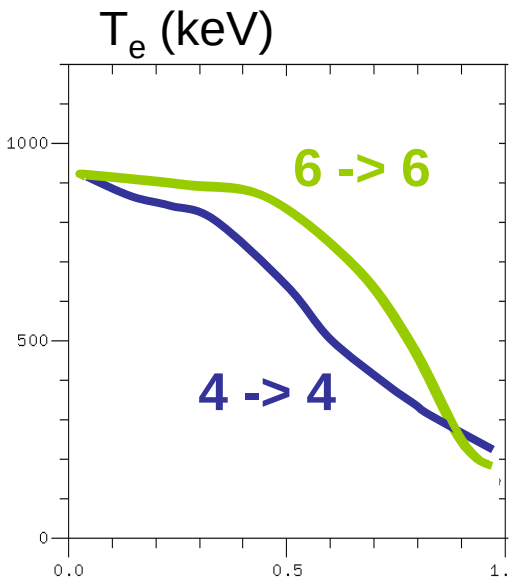


- **Large change in electron heating at fixed q, n_e, ω_{EXB}**
- **Supported by pellet results**
- **Very low ∇T_e^{crit} in central plasma; *heat flux drive* ?**
- **Does χ_e degrade less with P_{NB} at high B_t ?**
- **XP: I) Verify T_e broadening not fast ion effect**

  II) See how χ_e changes with P_{NB} at different B_t

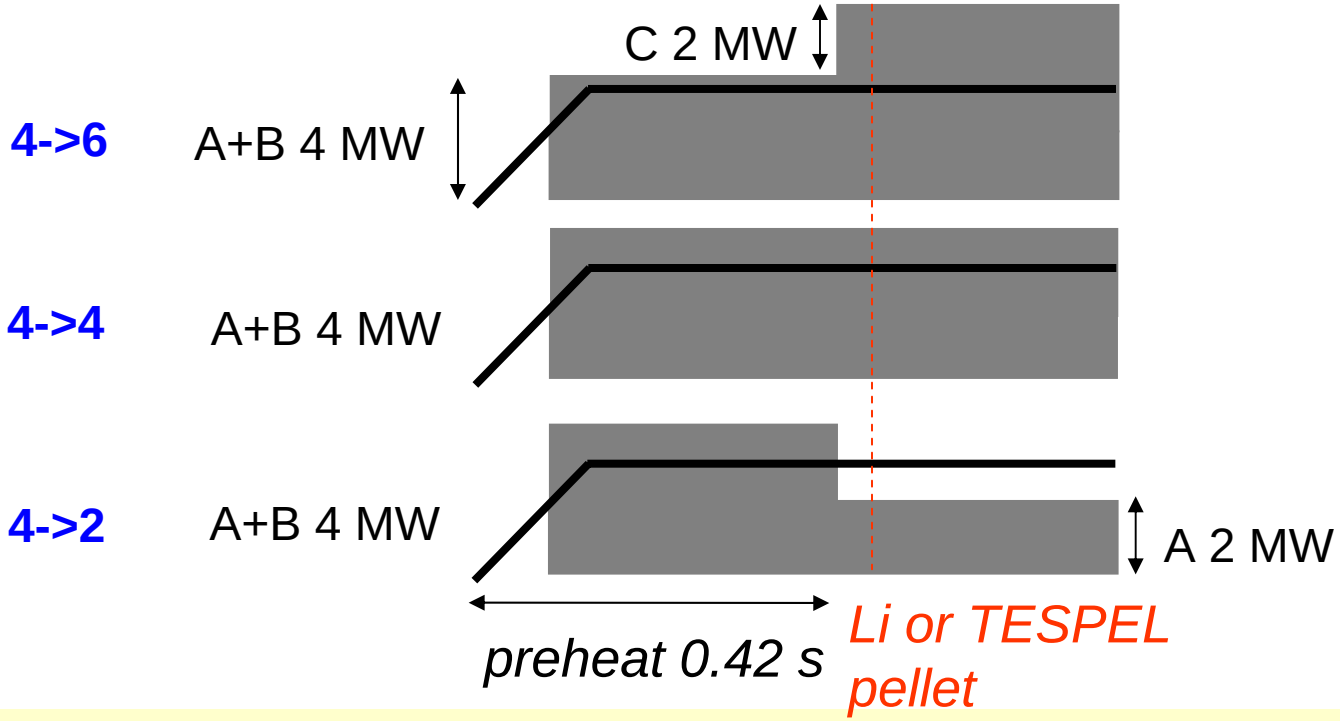
XP Part I: NPA scan at different P_{NB}





- **Confirm T_e broadening not due to fast ion redistribution**
- **Once electron transport effect confirmed, proceed to Part II**

XP Part II: χ_e change with P_{NB} at different 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, while keeping I_p/B_t fixed:**
  - **0.45 T/1 MA: 4->6, 4->4, 4->2 (re-establish baseline)**
  - **0.55 T/1.2 MA: 4->6, 4->4, 4->2**
  - **0.36 T/0.8 MA: 4->6, 4->4, 4->2**
- **Correlate transport changes with changes in high-k scattering**
- **Time permitting, inject pellets for fast δT_e,**