

# Correlation between impurity transport and $\mathbf{E} \times \mathbf{B}$ shear in beam-heated NSTX H-modes (Effect of rotation on impurity transport)

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# Testing the reduction of turbulence due to the $\mathbf{E} \times \mathbf{B}$ shear ?

Turbulent transport is supposed to be suppressed when the shearing rate from the  $\mathbf{E} \times \mathbf{B}$  is larger than the linear growth rate of the fastest growing mode involved in the transport.



$$\omega_{E \times B} \approx \left( \frac{RB_\theta}{B_\phi} \right) \frac{\partial}{\partial r} \left( \frac{E_r}{RB_\theta} \right) > \Gamma_{\max}$$

$$E_r = \frac{\nabla P_i(r)}{Z_i e n_i(r)} + v_\phi B_\theta - v_\theta B_\phi$$

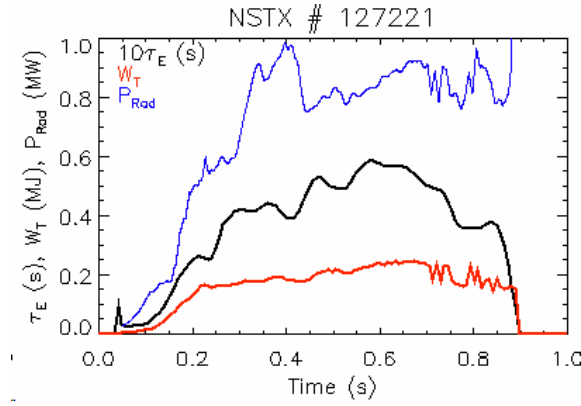
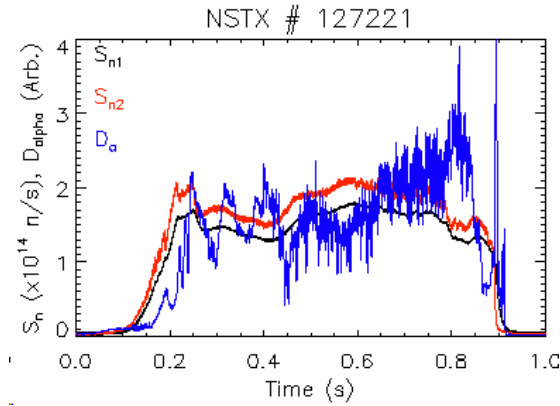
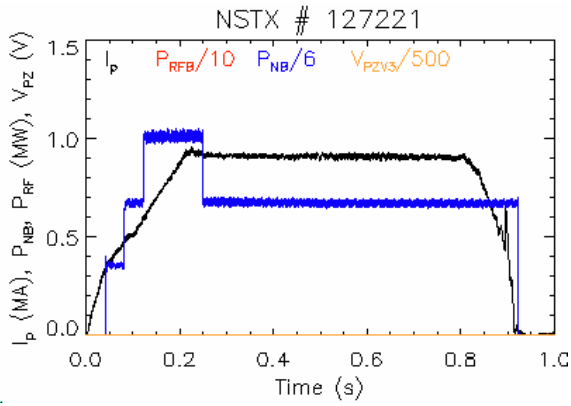
**Changing the  $\mathbf{E} \times \mathbf{B}$  by altering the toroidal velocity (rotation) should have an effect in the impurity transport**

Possible knobs:

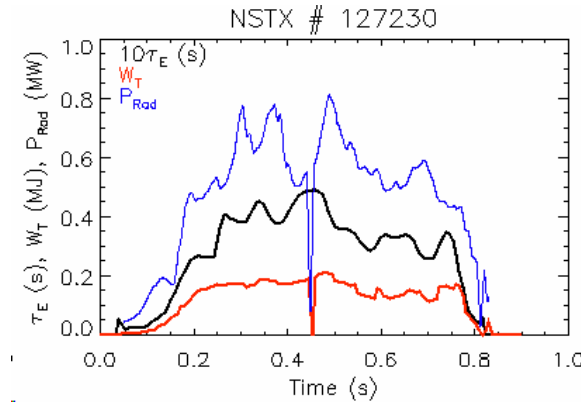
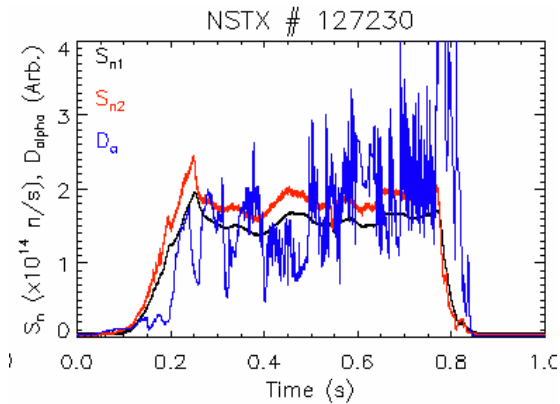
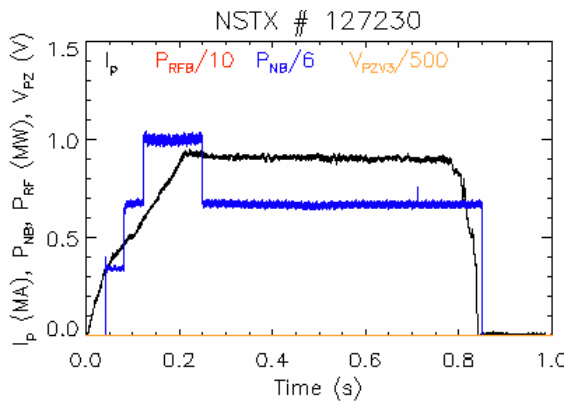
- Slowing down the plasma using the  $n=3$  magnetic braking
- Change the momentum input (NBI sources)

# XP812: Effect of rotation on confinement

127221: Background shot



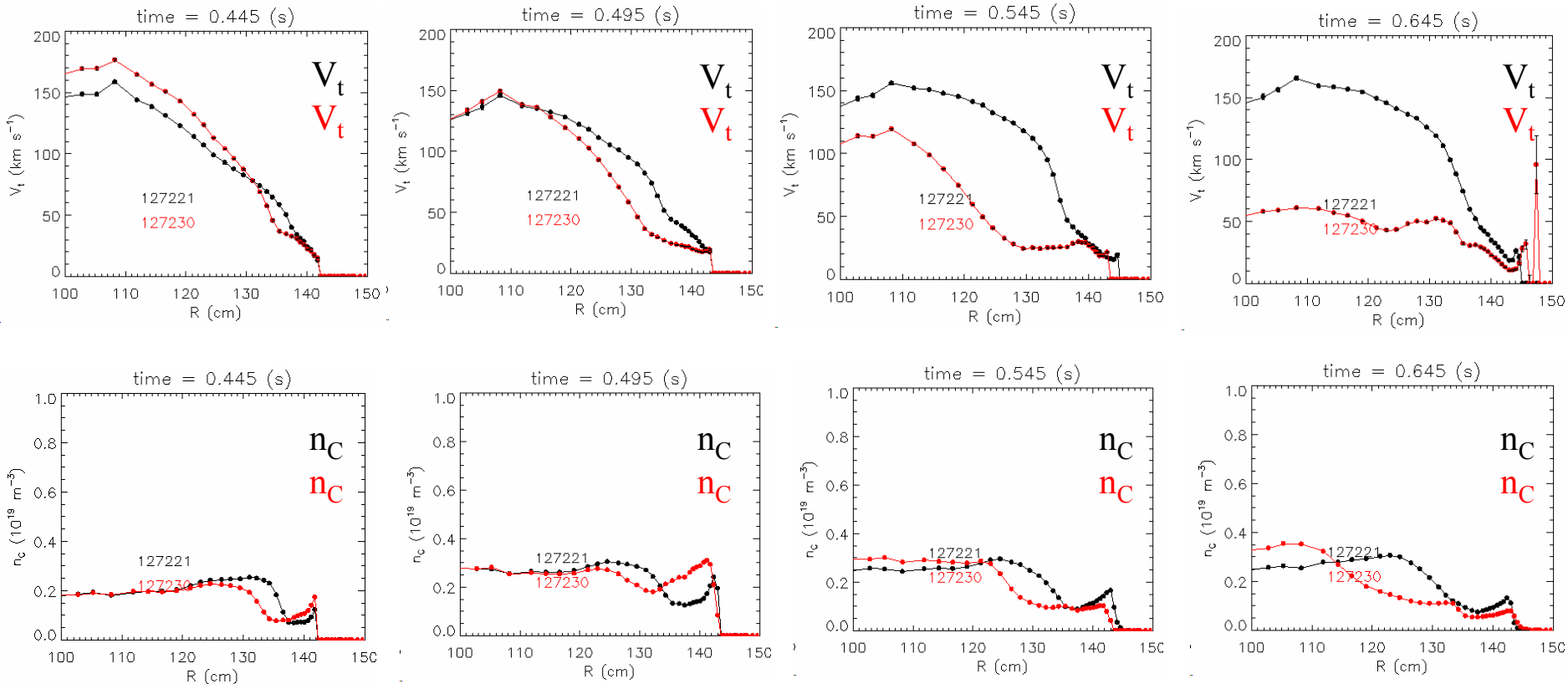
127230: SPA steps to 900 A  
(0.42-0.5 s) and 750 (0.5-1.0 s) A



# n=3 braking did reduce plasma toroidal rotation

127221: Background shot

127230: SPA steps to 900 A (0.42-0.5 s)  
and 750 (0.5-1.0 ms) A

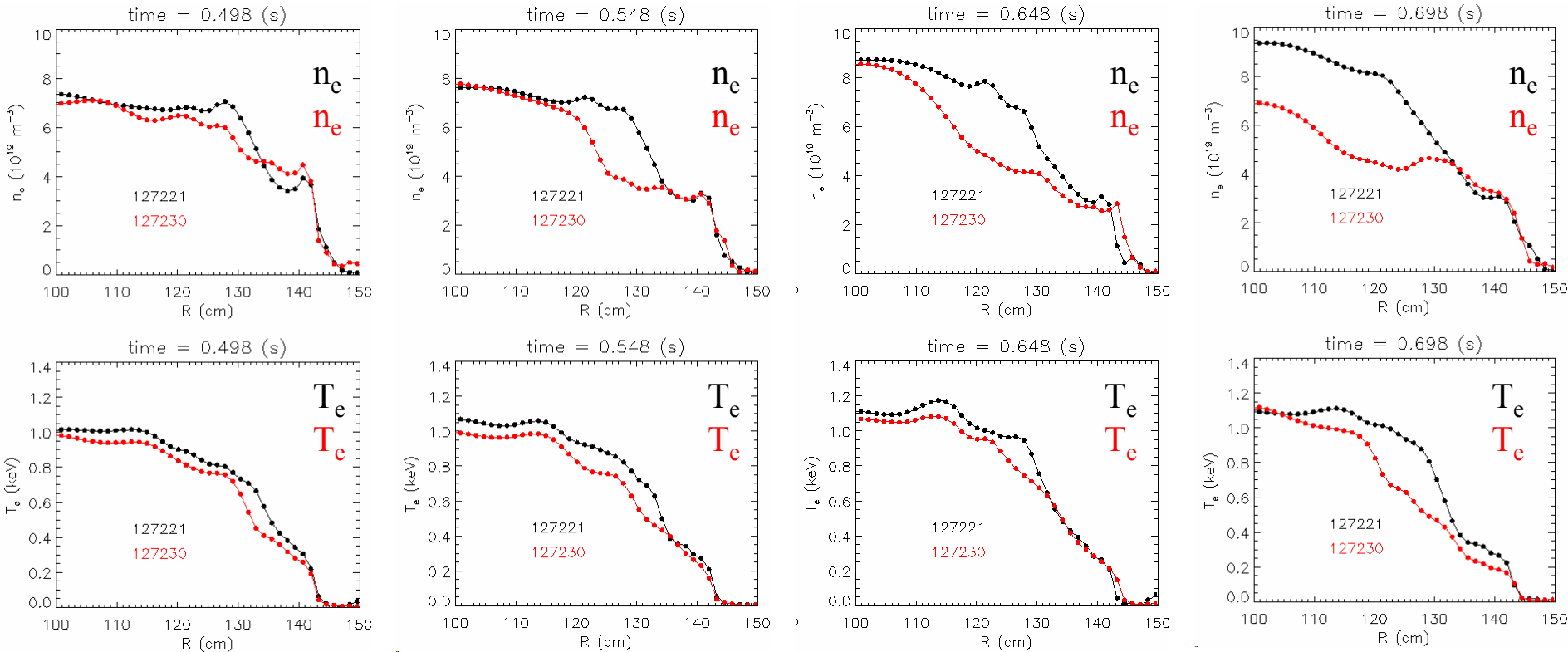


- Plenty of low-f MHD (Mirnov) near 550 ms and 600-700 ms enhanced rotation breaking.
- No USXR-OSXR information preclude us from telling where is the MHD!
- How reproducible were these shots?

# ...and also affected substantially the plasma profiles

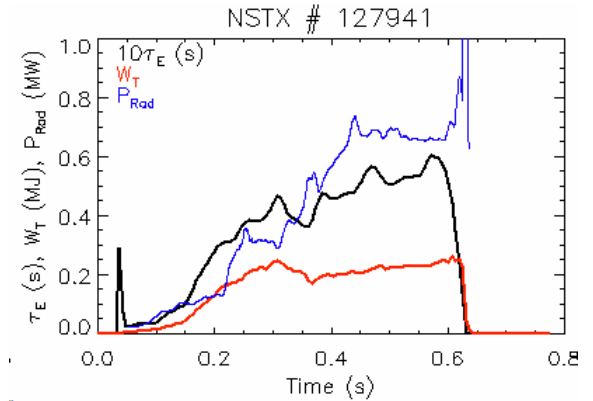
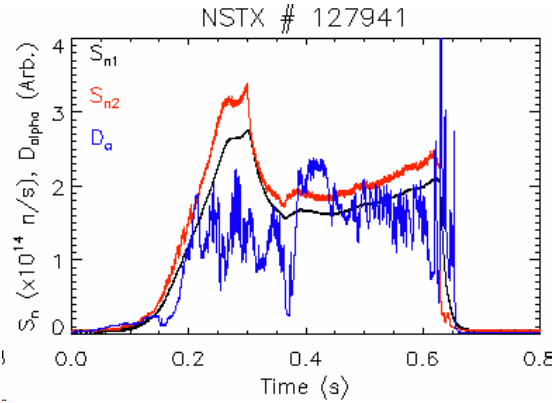
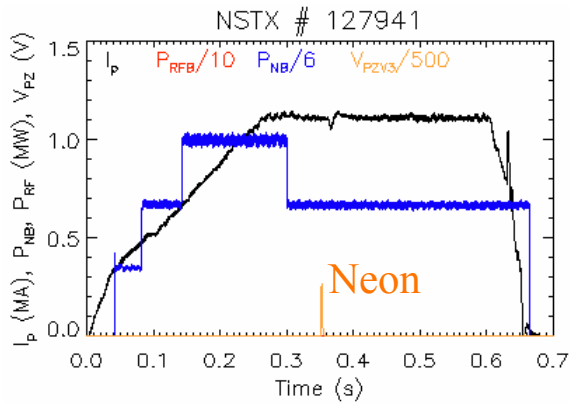
127221: Background shot

127230: SPA steps to 900 A (0.42-0.5 s)  
and 750 (0.5-1.0) ms) A

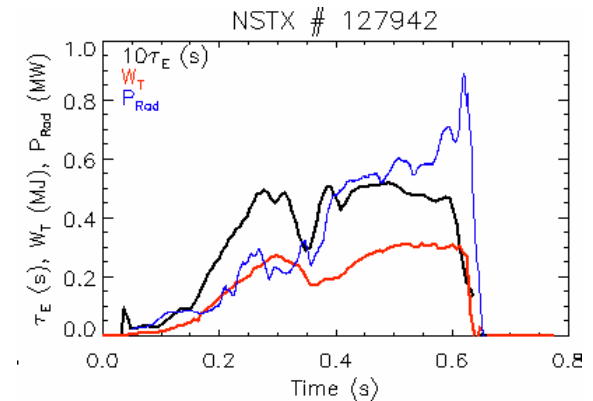
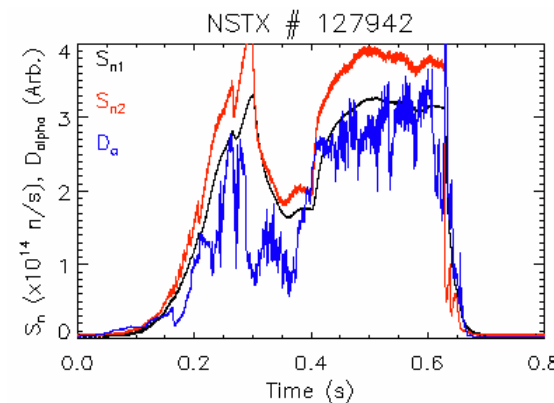
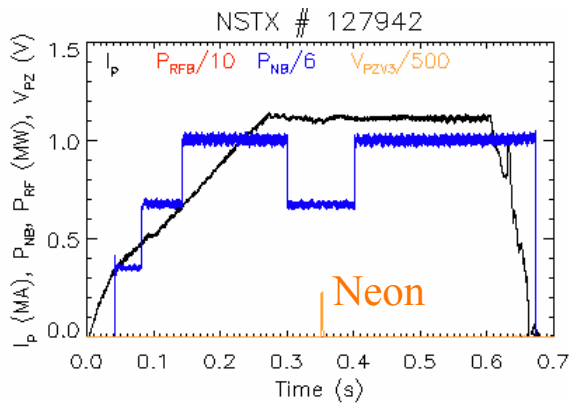


# Dan Stutman, XP 822

## 127941, H-mode, NBI: 4→4 MW

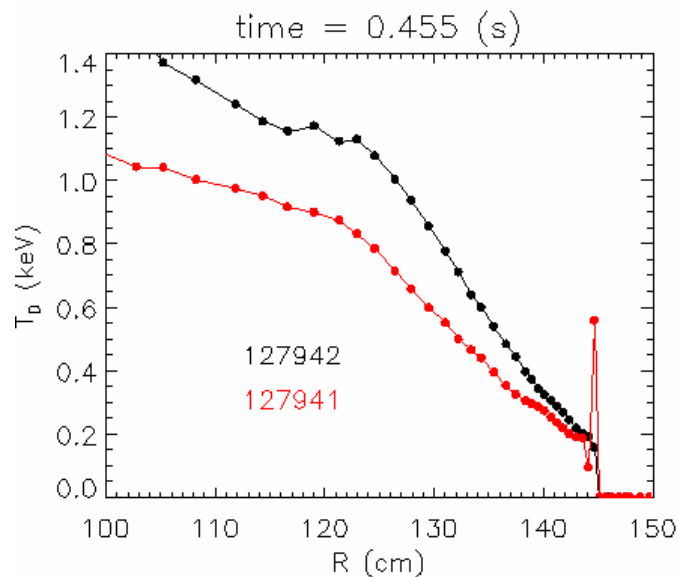
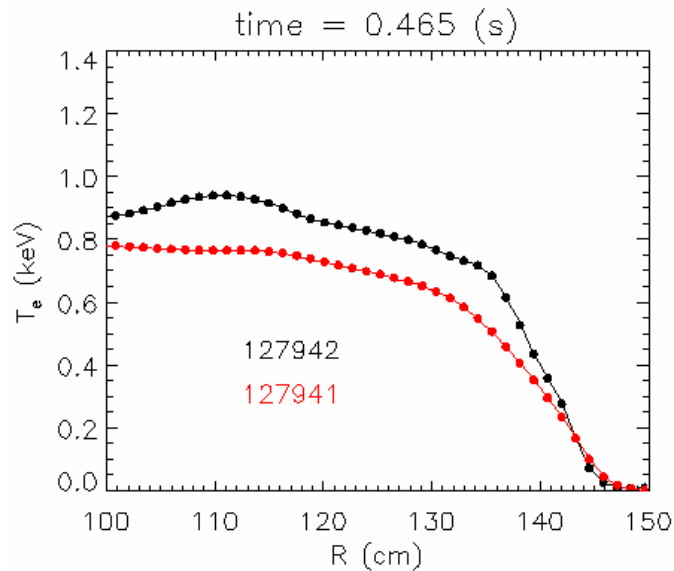
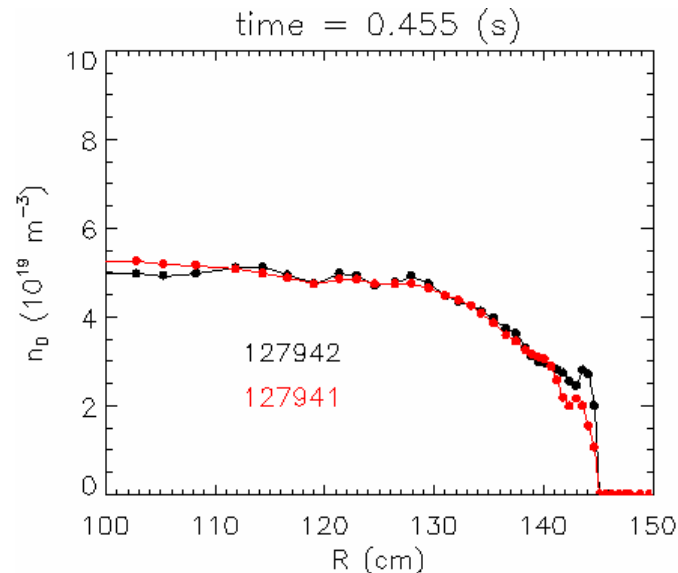
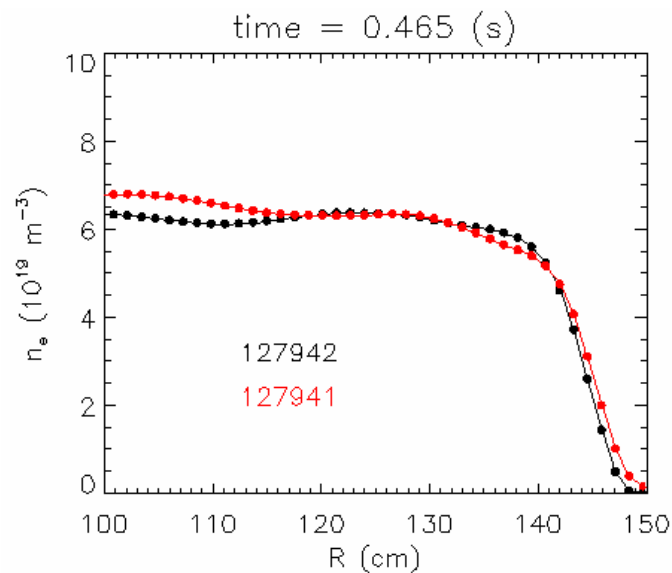


## 127942, H-mode, NBI: 4→6 MW

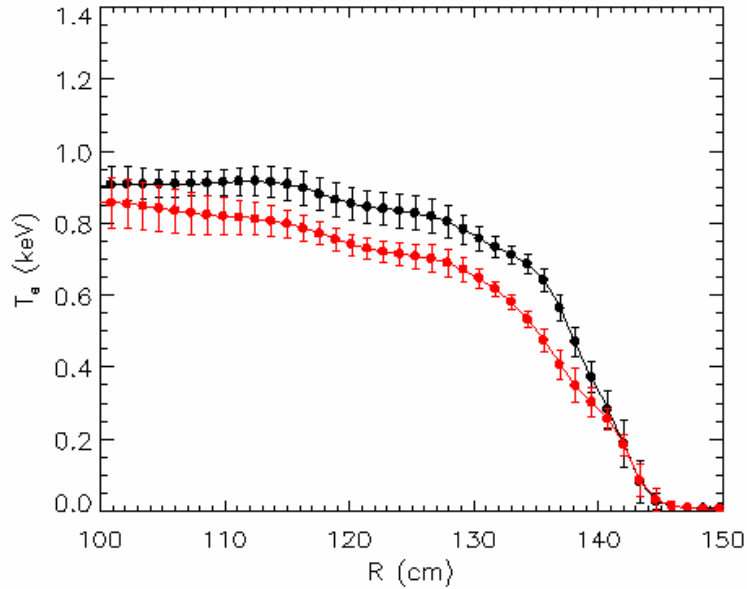


# Plasma profiles in XP 822 after the “NBI-step” @ 400ms

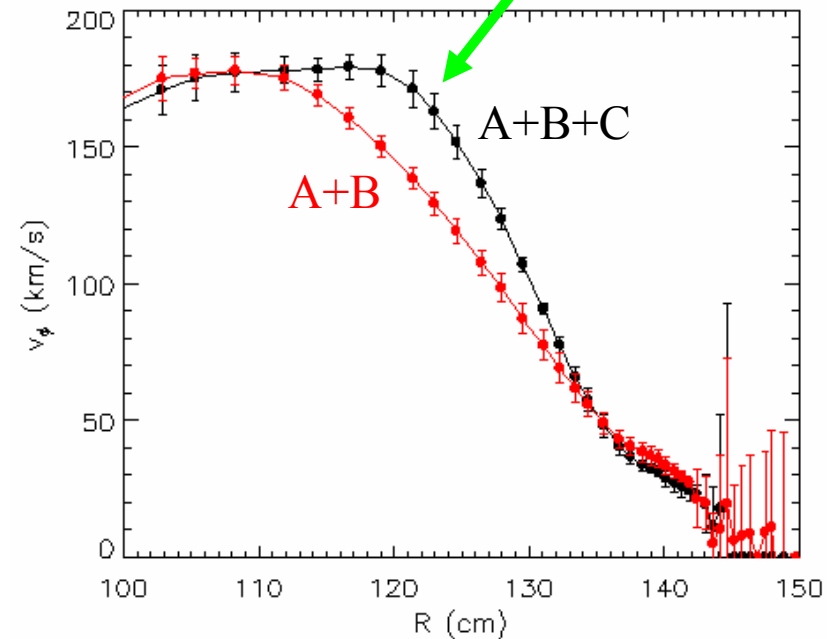
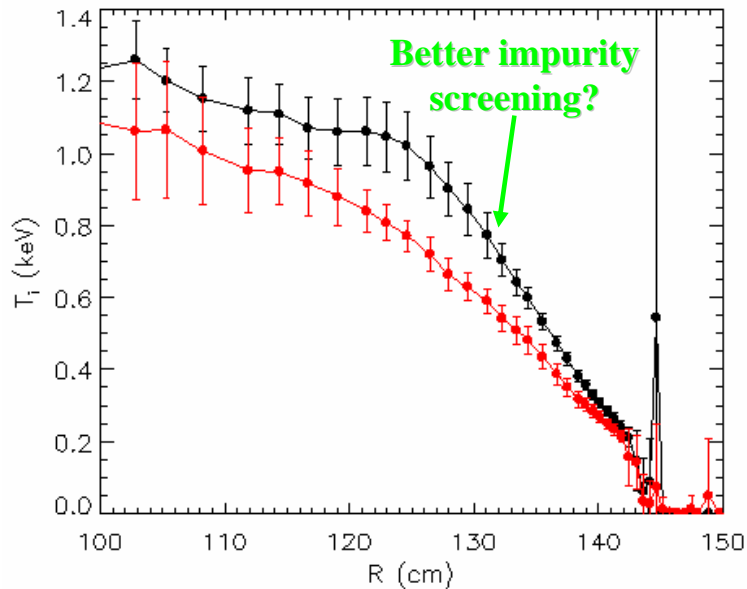
127941, H-mode, NBI: 4→4 MW  
127942, H-mode, NBI: 4→6 MW



# Average plasma quantities $t \in [430, 530]$ ms after NBI step



127941, H-mode, NBI: 4  $\rightarrow$  4 MW  
127942, H-mode, NBI: 4  $\rightarrow$  6 MW

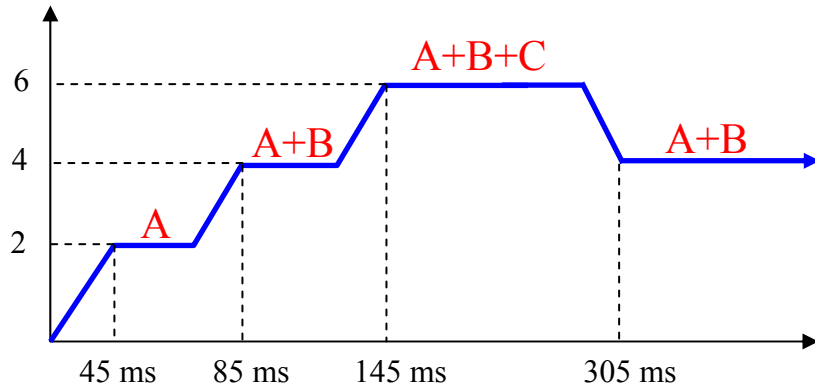




# Alternative method to change plasma rotation

## *NBI (pre-heating) recipe for XP 822*

PNBI (MW)

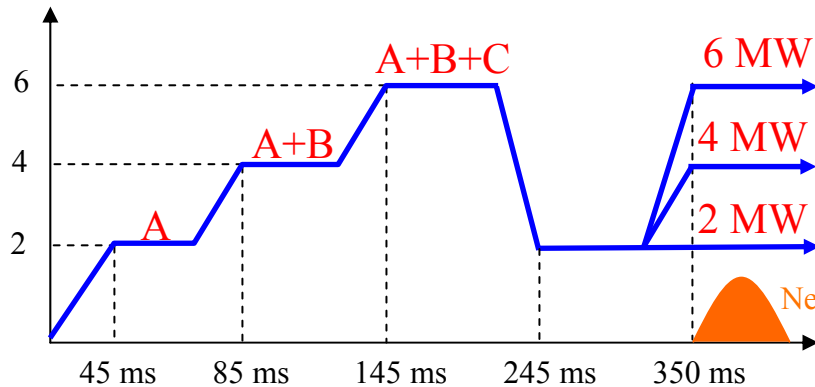


Notes for XP 822:

- All NBI sources at 90 kV!
- At 400 ms: add C  $\rightarrow$  6 MW  
drop B  $\rightarrow$  2 MW

## *NBI (pre-heating) recipe for impurity transport XP: 5.5 kG, 1.0 MA*

PNBI (MW): OPTION 2



• In the case src. C is powered at 70 kV then the maximum power will be 5.2 MW.

• Neon will be injected @ 1.5 Torr-l/sec within time window  $t \in [350, 360]$  ms

• We can also establish the baseline at 4 MW but in XP 822 the plasma got out of H-mode in the 4  $\rightarrow$  2 MW step.