Summary of XP813 – Momentum Transport Studies Using n=3 Non-Resonant Braking

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Momentum Transport Studies Using n=3 Non-Resonant Braking

NSTX

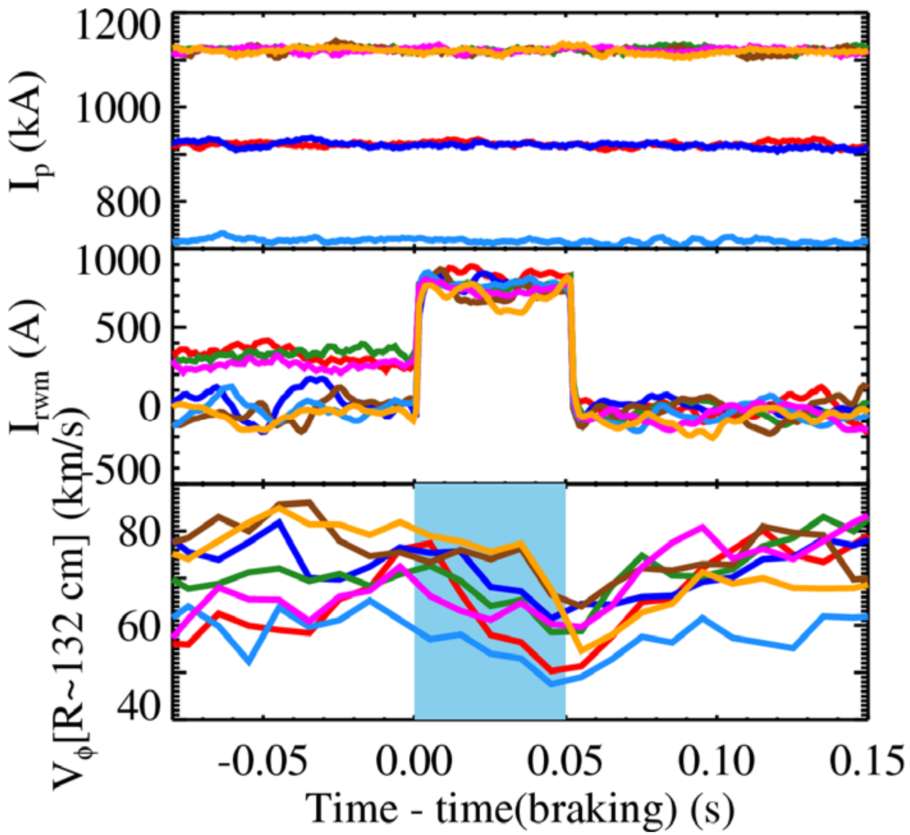
- Aim:
  Continue characterizing NSTX momentum transport
  - Experimentally distinguish turbulent pinch theories
    - ✓ Achieved large variation in density scale length, depending on when in the discharge the perturbation was applied
  - Look at I_p and B_ϕ variation in momentum transport (resolved into χ_ϕ and V_{pinch})
    - ✓ Successfully completed both I_p and B_ϕ scan

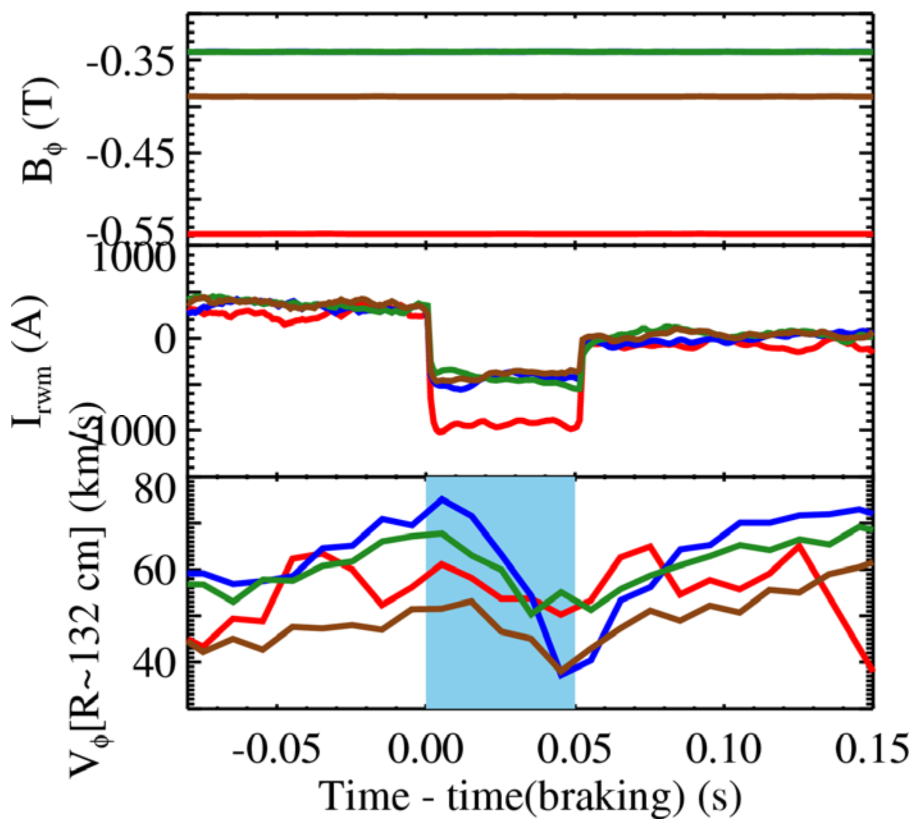
- Technique:
  - Use n=3 non-resonant magnetic perturbations to distort the rotation profile, allowing for separation of the roles of momentum diffusion vs non-diffusive (pinch).

Acquired Excellent Data for Both I_p and B_t scans

NSTX

- TRANSP analysis performed to investigate rotation relaxation following perturbation
  - Does χ_ϕ (and V^{pinch}) scale like χ_i or does e- transport matter?





n=3 Perturbation Provided Necessary Non-Local Distortion to Rotation Profile

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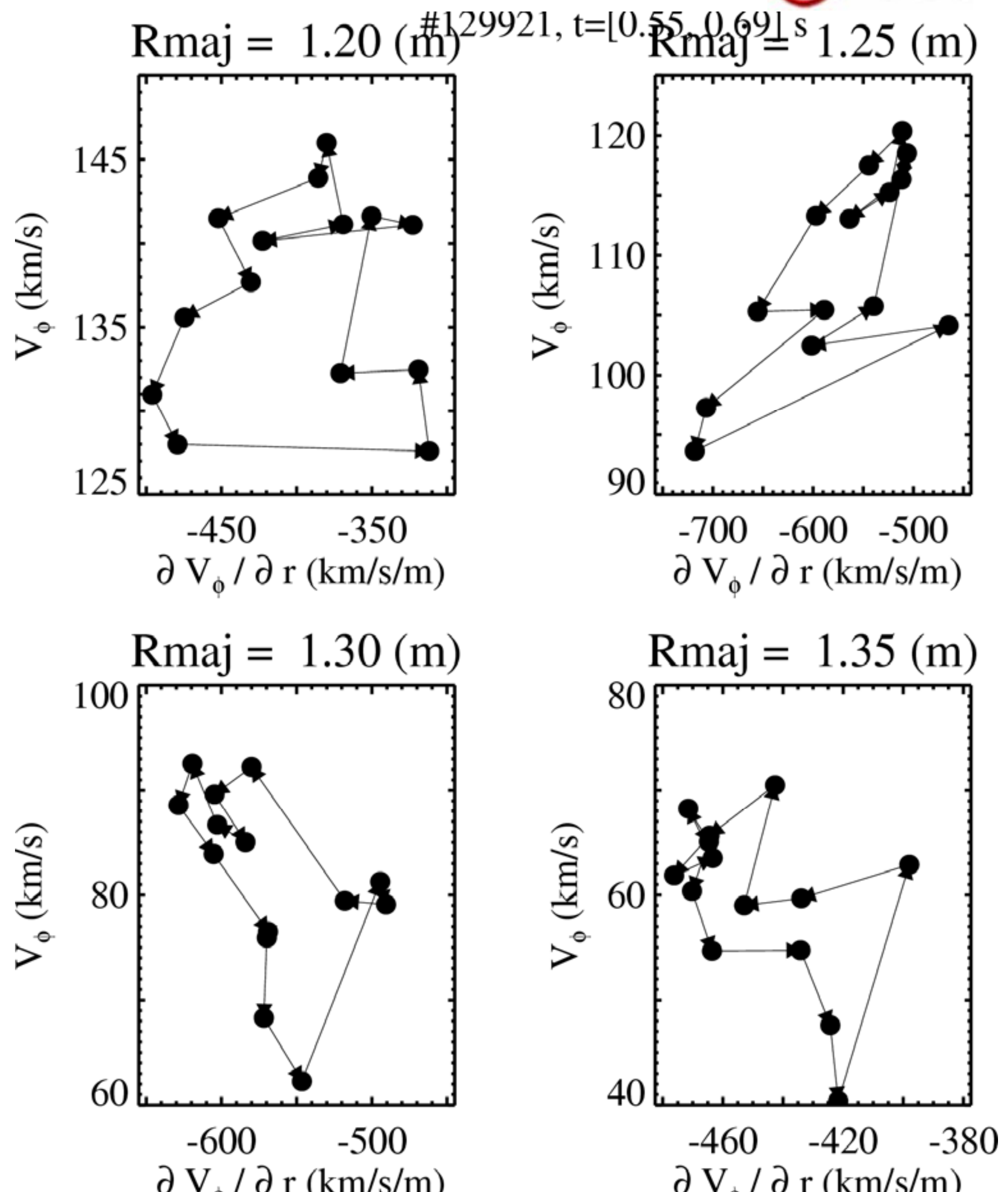
- Simple model for momentum flux

$$\Gamma_\phi = -mnR\left(\underbrace{\chi_\phi \frac{\partial V_\phi}{\partial r}}_{diffusion} - \underbrace{V_\phi V_\phi^{pinch}}_{convection}\right)$$

- Elliptic tracks of dV_ϕ/dr vs V_ϕ indicate that determination of χ_ϕ and V_ϕ^{pinch} possible.
  - Must change V_ϕ independently of dV_ϕ/dr to avoid collinearity of data set



No Obvious Correlation Identified Between Momentum Transport Profiles and B_t or I_p

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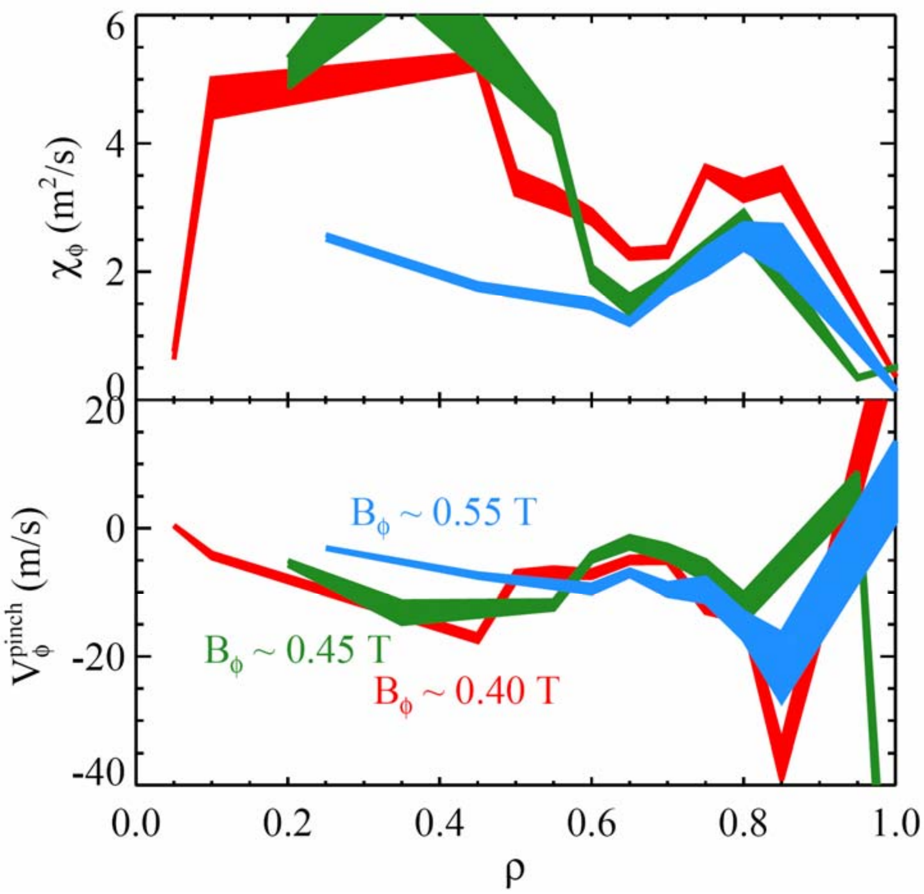
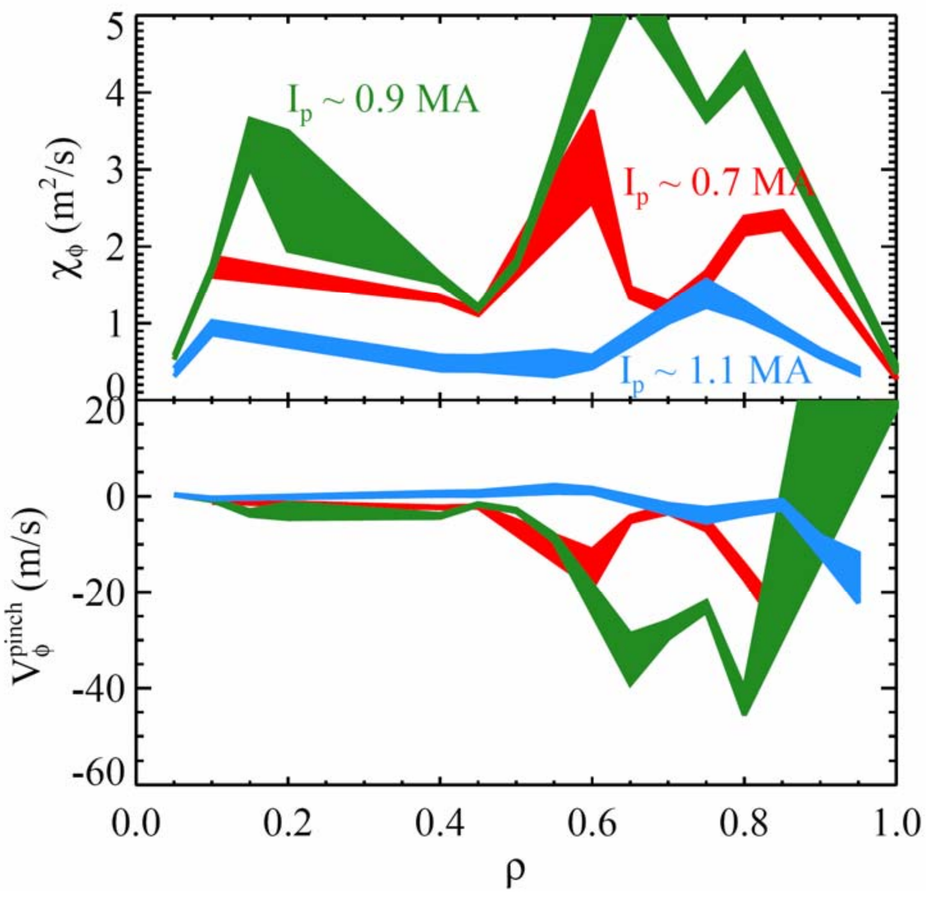
- Different to thermal transport (Kaye et al PRL 2007)

B_t scan



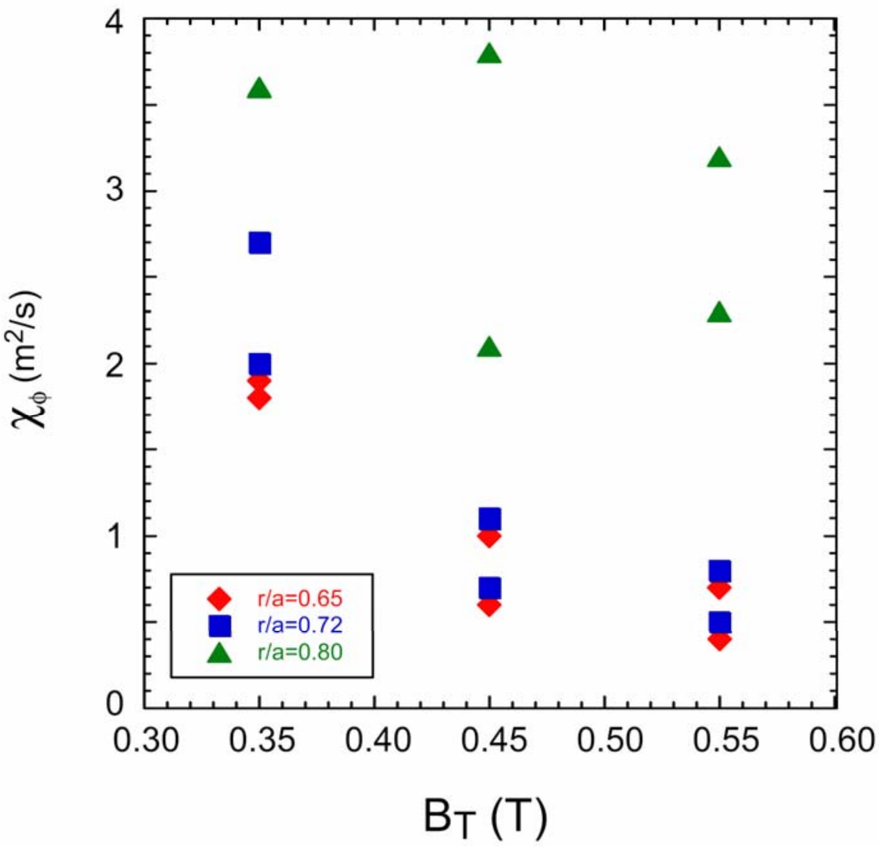
I_p scan

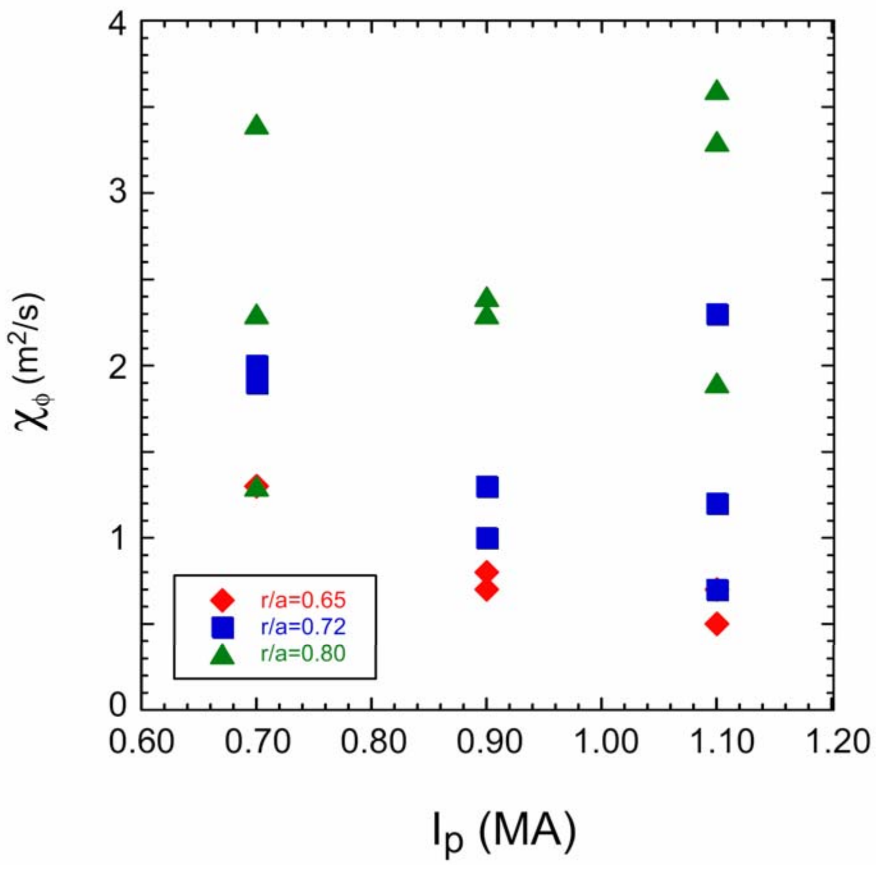


Perhaps a Weak Dependence of χ_ϕ with B_t at Select Radii

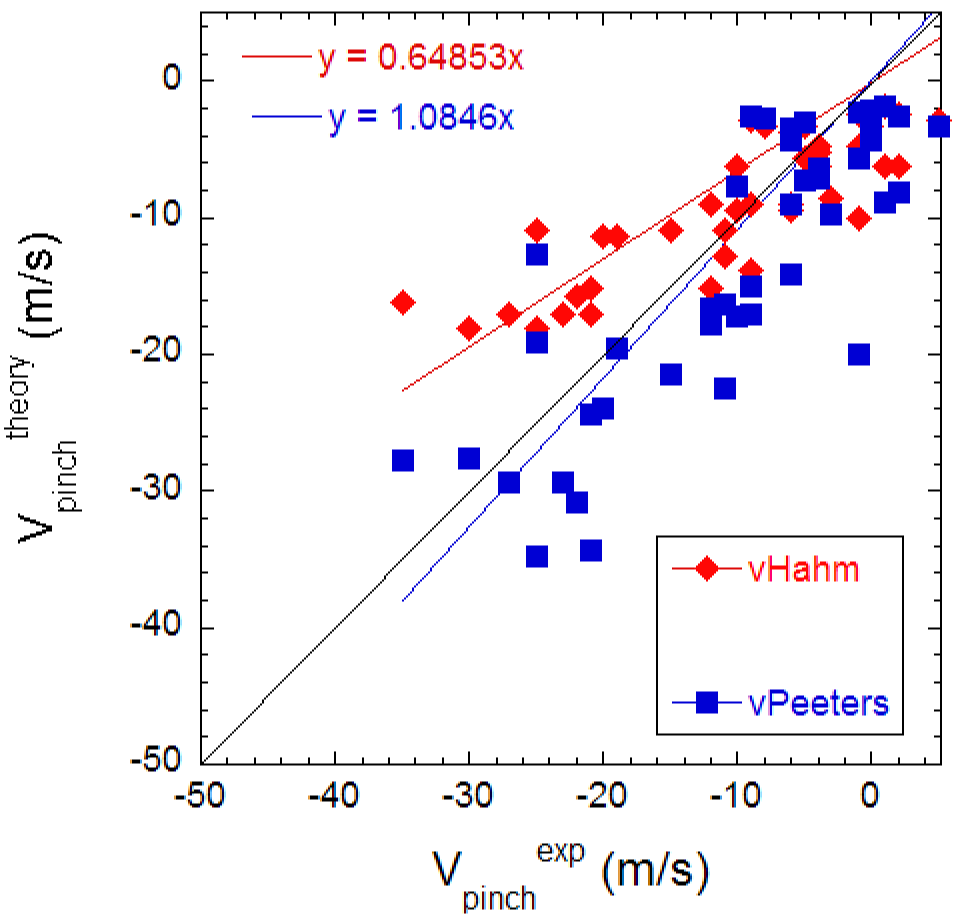
NSTX

χ_ϕ shows some reduction with B_t





Variation in Density Scale Length: Permits Comparison of Theory for Momentum Pinch



- Inclusion of gradient scale length appears to give a better fit to the experimentally determined pinch velocity