

Exploration of improved electron confinement in shear reversed L-mode discharges

D. Stutman, M. Finkenthal, K. Tritz

Johns Hopkins University

S. M. Kaye, R. E. Bell, M. G. Bell,

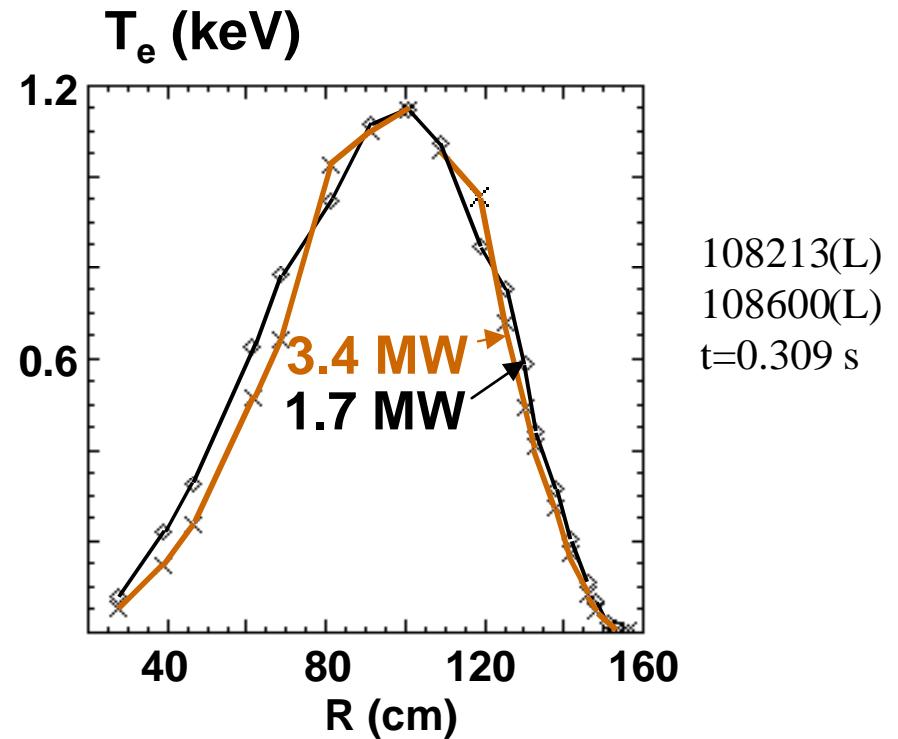
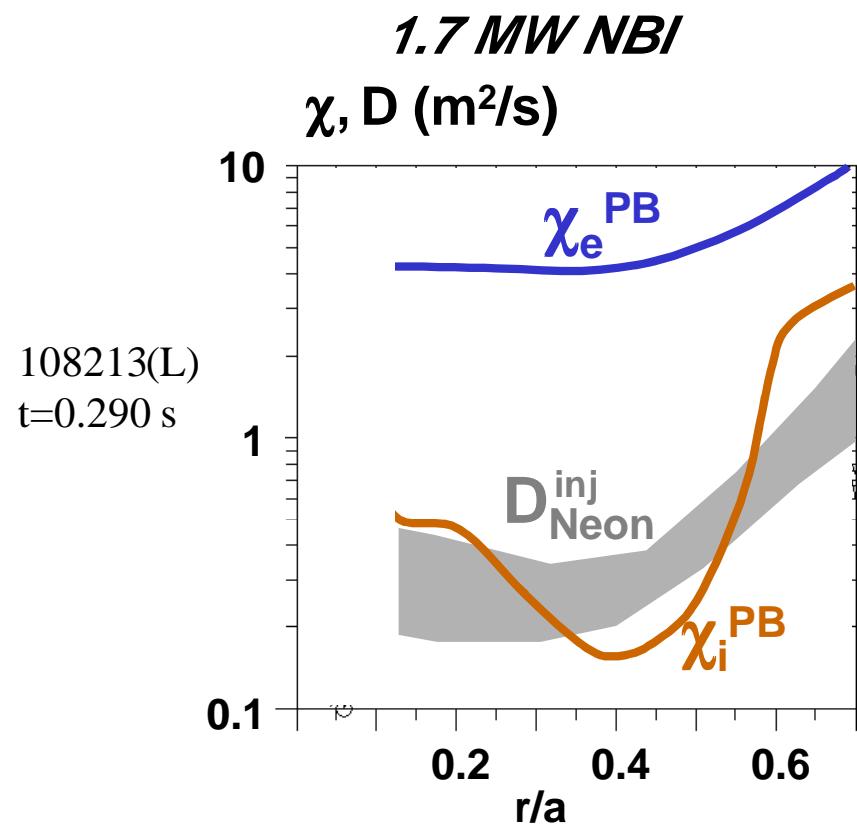
K. Hill, B. P. LeBlanc, J. E. Menard, E. J. Synakowski

Princeton University

C. Bourdelle

Association Euratom-CEA, France

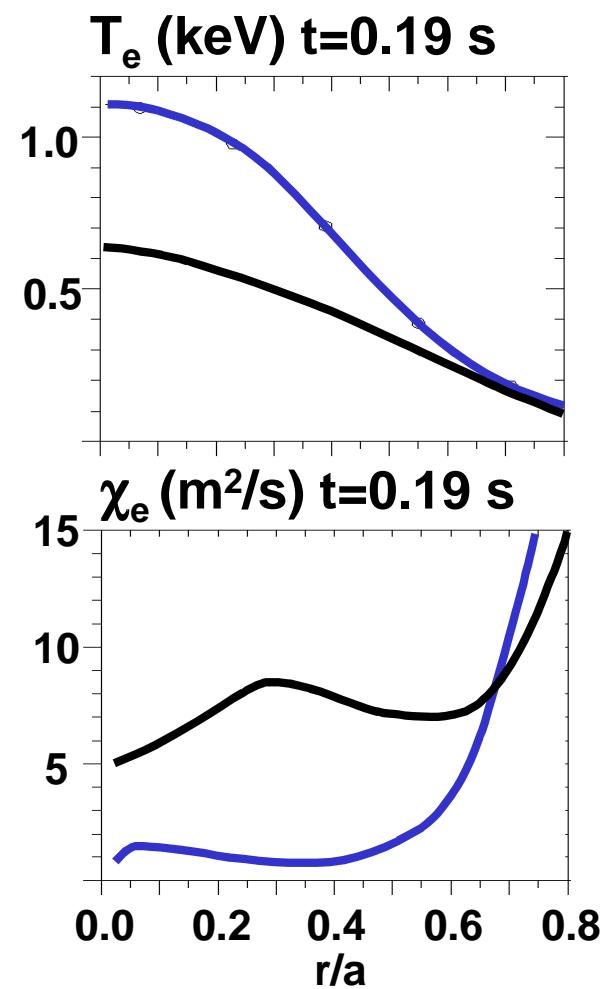
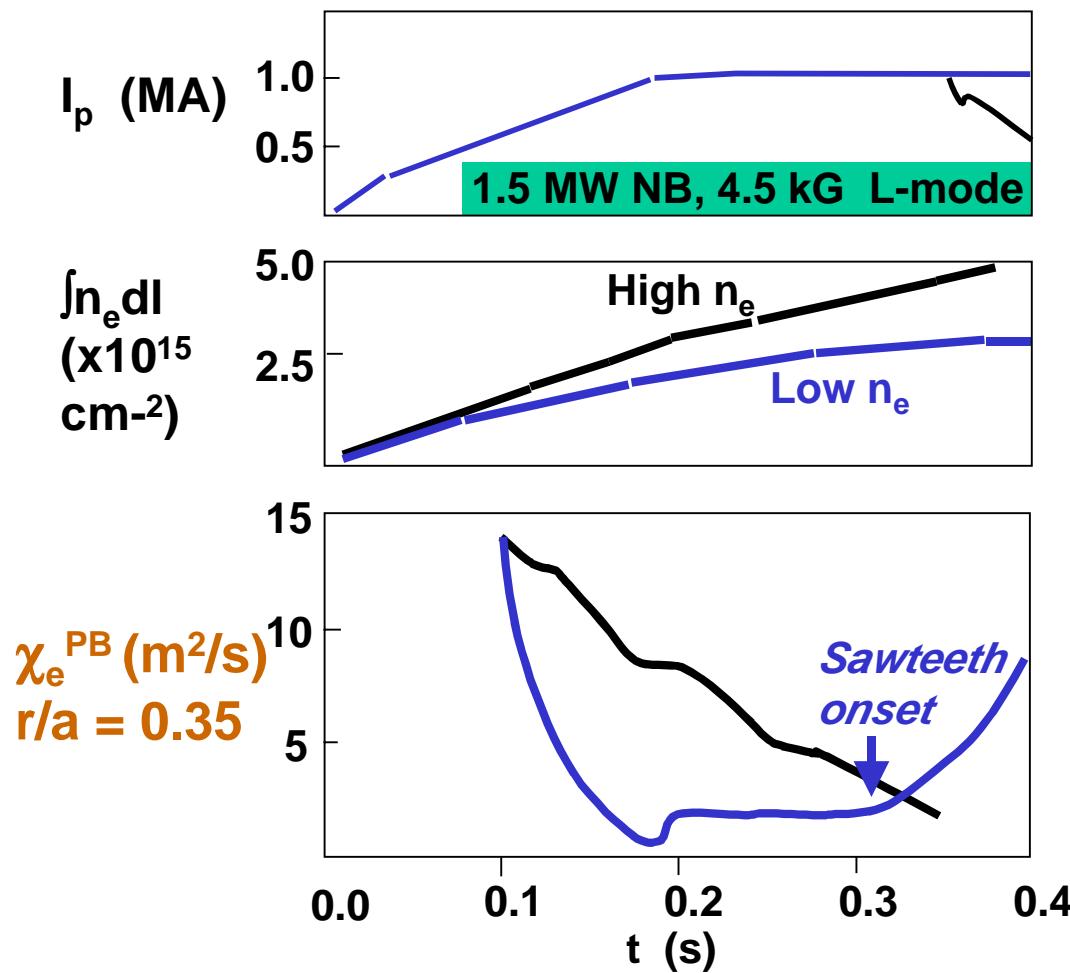
Strong electron transport in NSTX L-mode



- $\chi_i, D_{\text{imp}} < 1 \text{ m}^2/\text{s}$ (\approx neoclassical)
- $\chi_e >$ several m^2/s

- Stiff T_e profiles

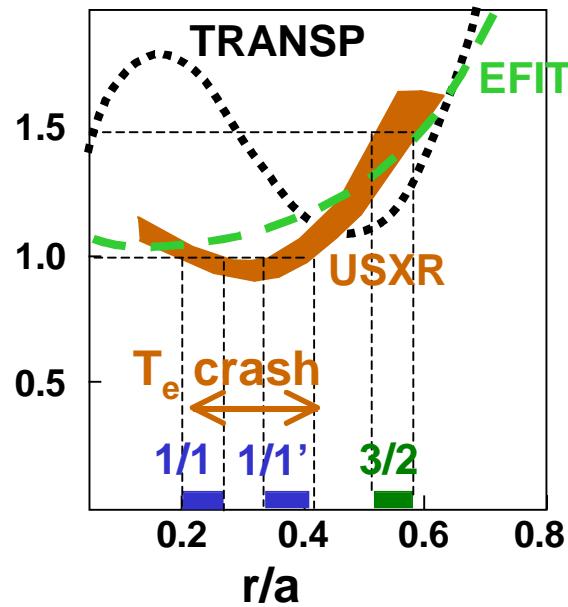
Electron transport improves in low n_e regime



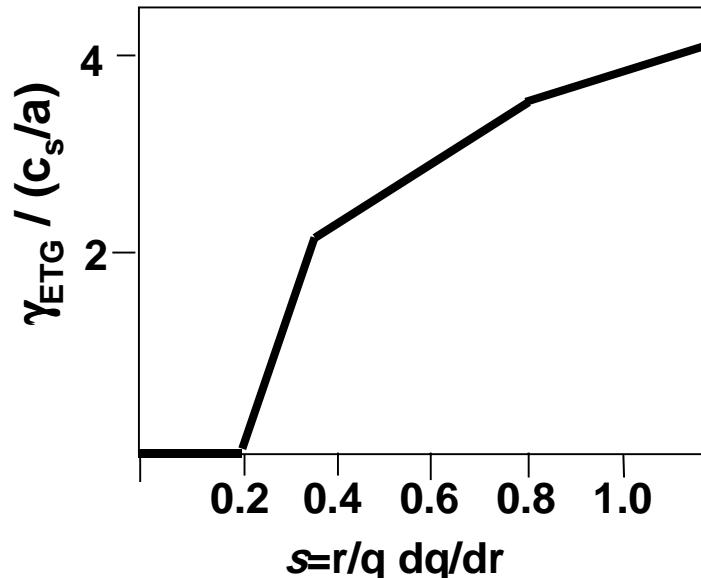
- Large χ_e decrease with early NB injection into low n_e discharge
- Global confinement significantly improves (although χ_i increases)

Estimated q-profile is reversed

Estimated $q(r)$ $t=309$ ms



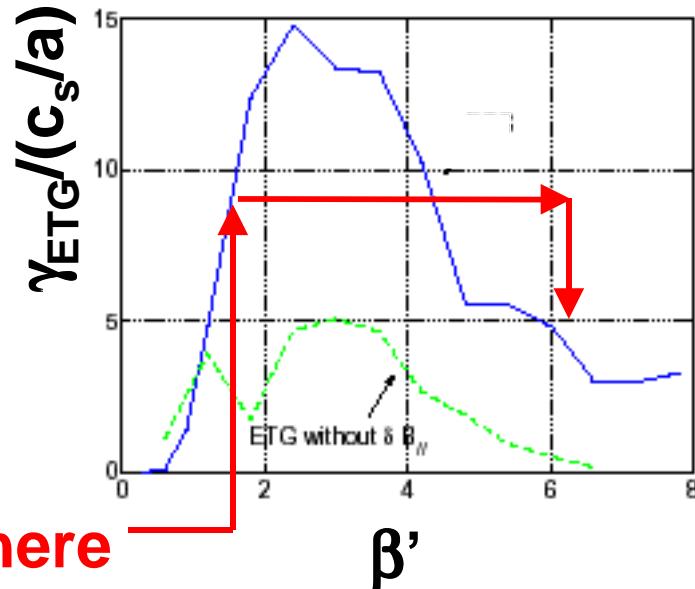
ETG growth rates at $r/a=0.5$
(C. Bourdelle, GS2)



- Both USXR and TRANSP estimate negative/low shear
- Microstability calculations indicate ETG suppression for $s \leq 0$
- Strong electron transport likely low A and not low field effect
(large s in grad T_e region ?)

Shear reversal may help access higher confinement

β' confinement enhancement mechanism (C. Bourdelle)



- Shear reversal confinement gain likely transient
- ETG (and ITG) growth rates decrease at high β' (positive feedback)
- Transient shear reversal may enable accessing high β' regime
- Studying ‘knob’ on electron transport in any case important

Goals of proposed XP (2 days)

- Optimize I_p ramp-rate, κ and δ in order to promote shear reversal and maximum T_e gain (I_p ramp scan will also test reversal assumption)
- Explore response of T_e profile to increased beam power, RF power, plasma density and current at moderate beta
- Attempt to trigger beta-prime mechanism by increasing β through lower B and higher n_e

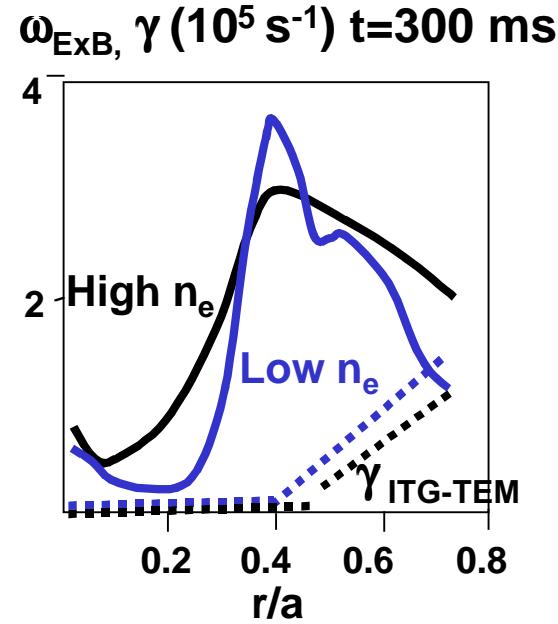
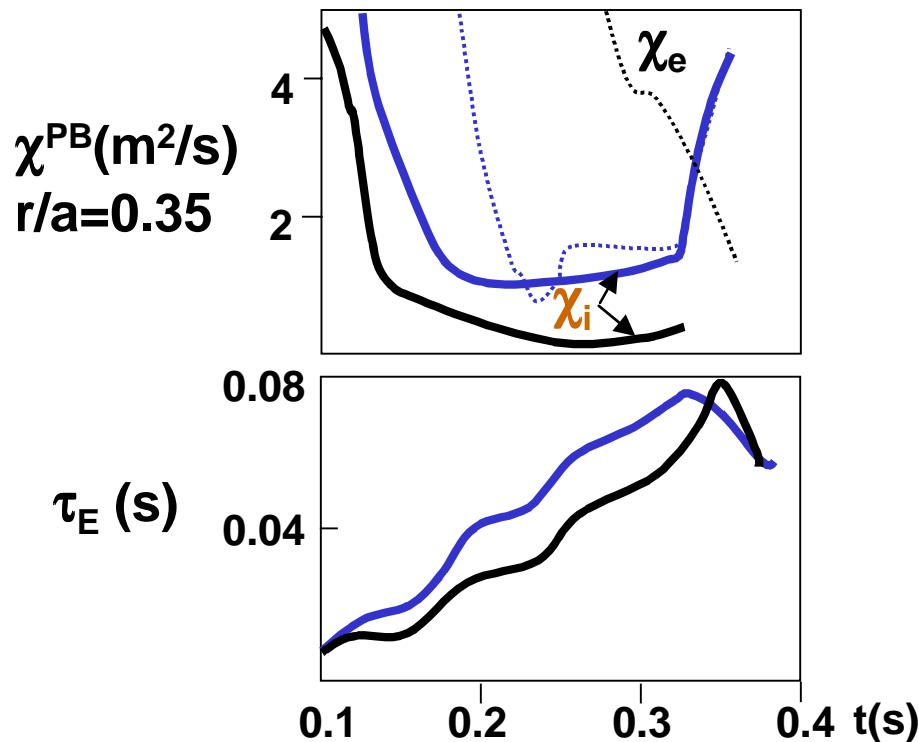
Accompanying measurements

- Neon injection for ion transport
- MSE/core X-ray imaging/USXR fluctuations for $q(r)$ estimate
- Turbulence correlation lengths at $r/a \geq 0.9$

Experimental conditions

- DND, $\delta=0.7$ L-mode, 1 MA, 4.5 kG, #108918 baseline
- Fresh boronization
- Two shots per condition
- 2 run days

Ion transport increases in reduced χ_e regime



- χ_i, D_{Neon} increase to $\approx \chi_e$ in low density discharge
- Global confinement nevertheless increases (up to $\approx 2.5 \times \tau_{89-\text{P}}$)
- Decreased core ω_{ExB} in low n_e shot (flatter V_t profile)
- ITG-TEM growth rates increase 30-40% (decreased T_i/T_e)
- However, ω_{ExB} still exceeds $\gamma_{\text{ITG-TEM}}$ over most of the radius
- Inverse correlation between electron and ion turbulence ?