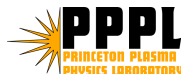

Theory of Gyro-Center Shift and NSTX Results

K.C. Lee,

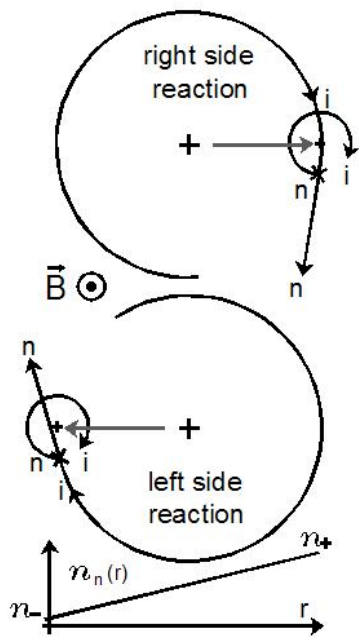
University of California at Davis

NSTX Research Team

NSTX result review Aug 6-7, 2008



Turbulence Diffusion and H-mode Transition in Conjunction with Gyro-Center Shift



$$J_r^{GCS} = en_i \frac{r_{Li}}{\lambda_{i-n}} \left(\frac{E}{B} - \frac{1}{eB} \frac{\nabla P_i}{n_i} + \frac{kT_i}{eB} \frac{\nabla n_n}{n_n} \right)$$

Gyro-Center Shift

Turbulence Induced Diffusion

$$D = \frac{2 \tilde{n}}{\pi n} \left(\frac{\tilde{n}}{n} + \frac{\lambda_t}{2L_{\tilde{n}}} \right) \frac{kT_i}{eB}$$

Submitted PPCF 2008

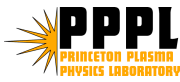
E_r Formation
PoP 2006

Arc Discharge
PRL 2007

Reynolds Number of Ion-Neutral Collision

$$Re = \frac{eB}{kT_i} \lambda_{i-n} \left(\frac{E}{B} - \frac{1}{eB} \frac{\nabla P_i}{n_i} + \frac{kT_i}{eB} \frac{\nabla n_n}{n_n} \right)$$

LH Transition on NSTX
Invited Talk APS 2006



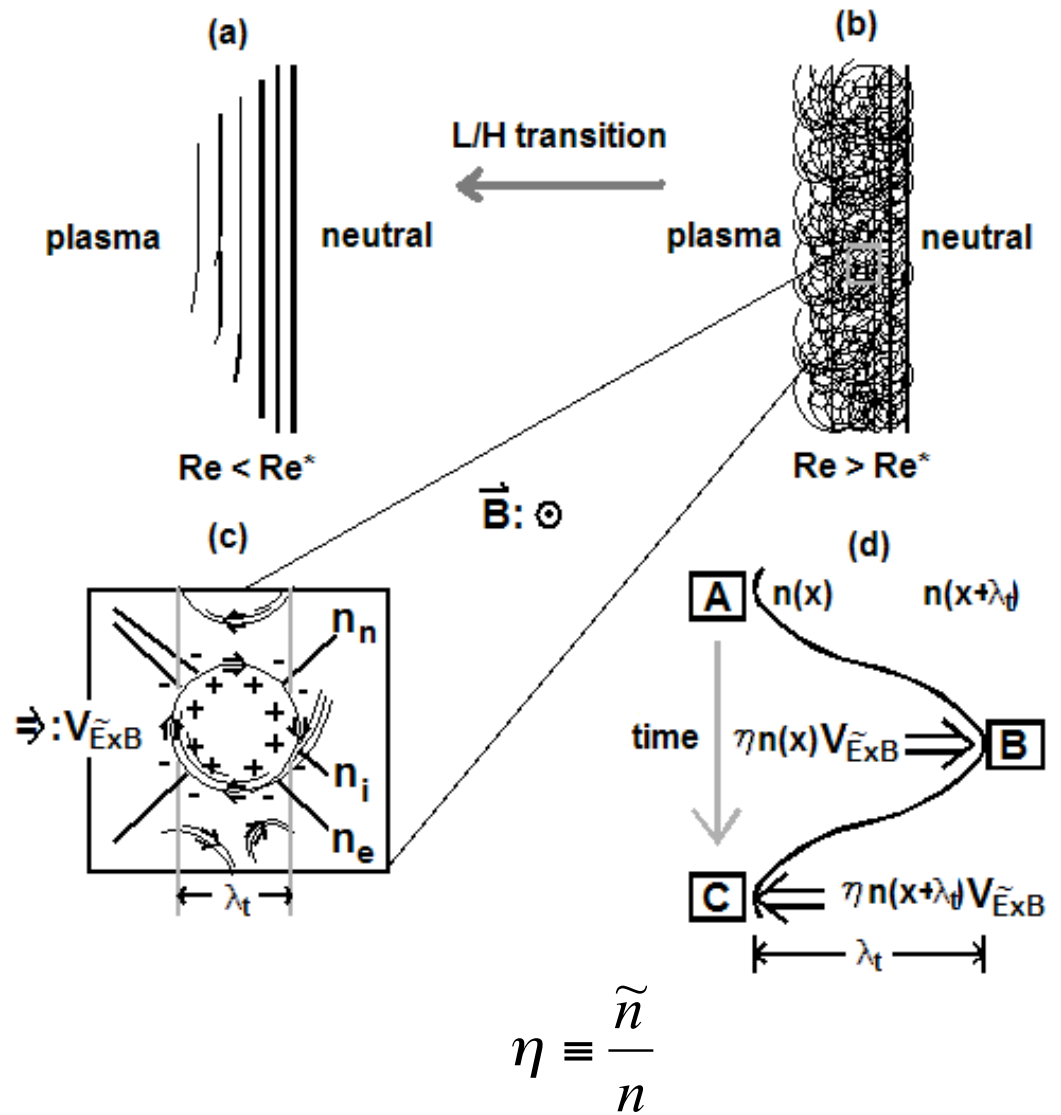
Turbulence Induced Diffusion

$$\Gamma \approx \partial n \cdot \tilde{v}$$

$$\eta \lambda_t \nabla n \quad V_{\tilde{E} \times B} = \frac{\tilde{E}}{B}$$

$$\frac{e \tilde{E} \lambda_t}{2} \approx \eta k T_e$$

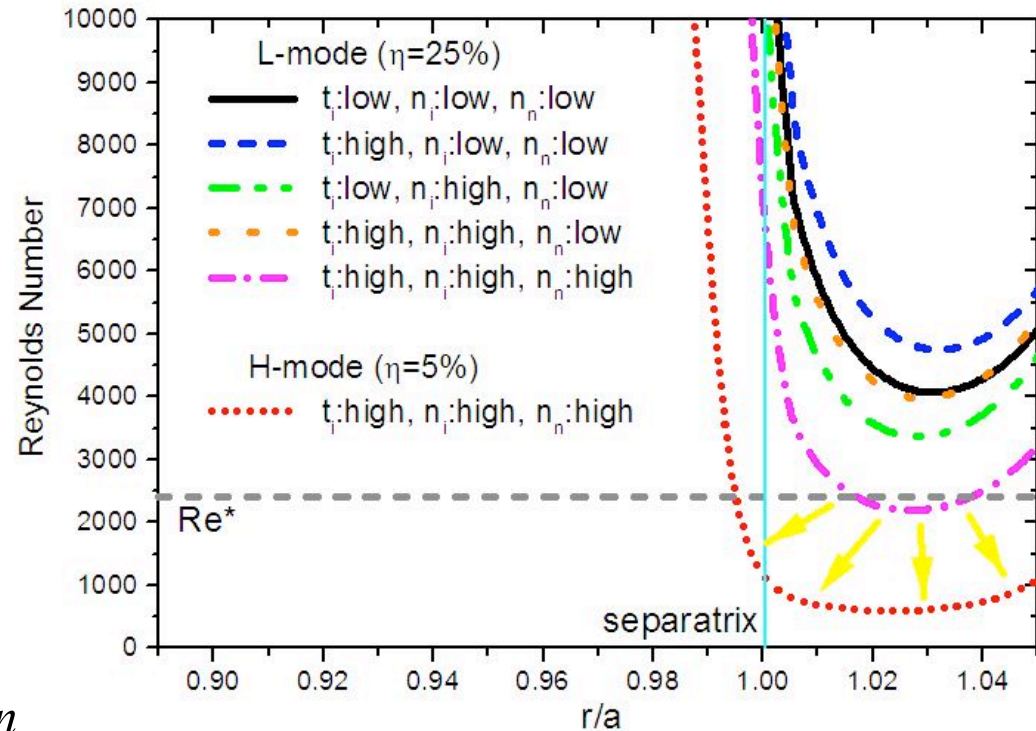
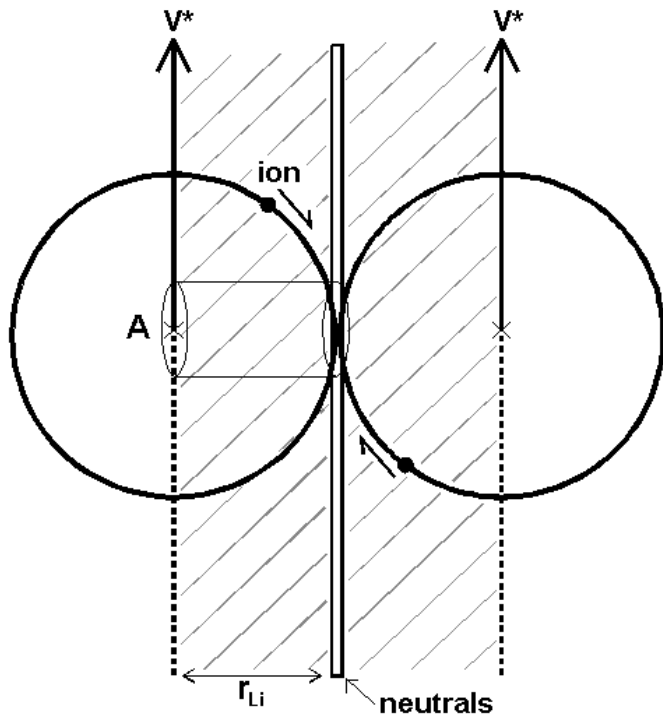
$$D = \frac{2}{\pi} \eta^2 \frac{k T_e}{e B}$$



Reynolds Number of Ion-Neutral Collision

$$\text{Re} \equiv \frac{n_i m_i v^{*2} / r_{Li}}{n_i m_i \nu_{i-n} v^*} = \frac{eB}{kT_i} \lambda_{i-n} v^* \longrightarrow \frac{2}{\pi} \eta \left(\eta + \frac{\lambda_t}{2L_{\tilde{n}}} \right) \frac{B}{m_i n_i (\sigma_{i-n} n_n)^2 v_{\perp}} \nabla \rho$$

Saturation Condition of J_{GCS}



$$v^* = \frac{E}{B} - \frac{1}{qB} \frac{\nabla P_i}{n_i} + \frac{kT_i}{qB} \frac{\nabla n_n}{n_n}$$



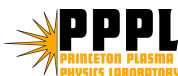
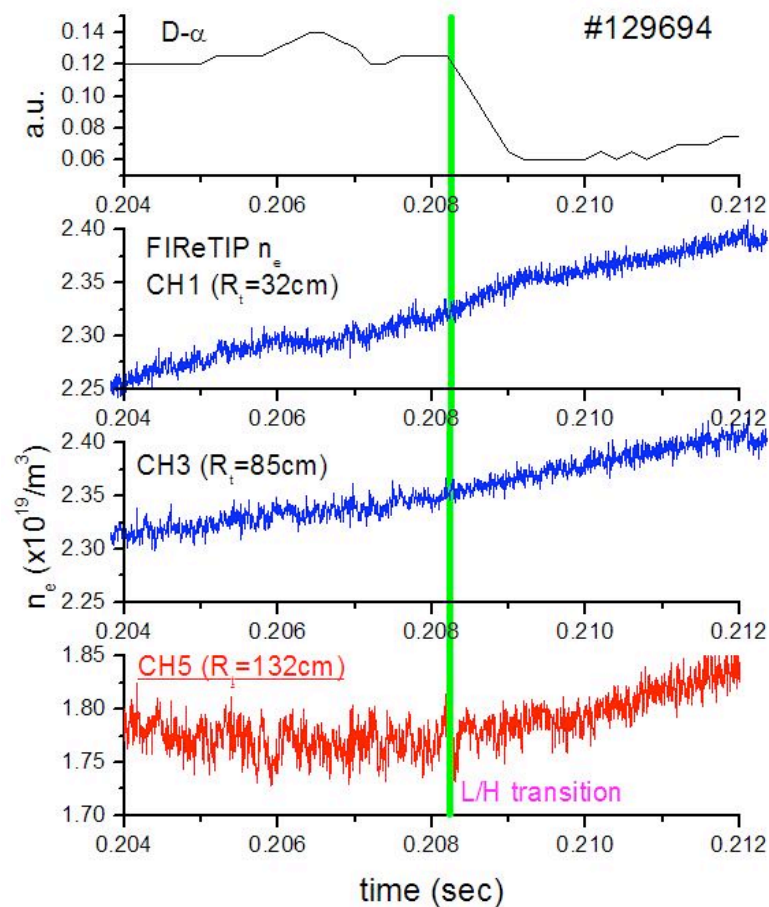
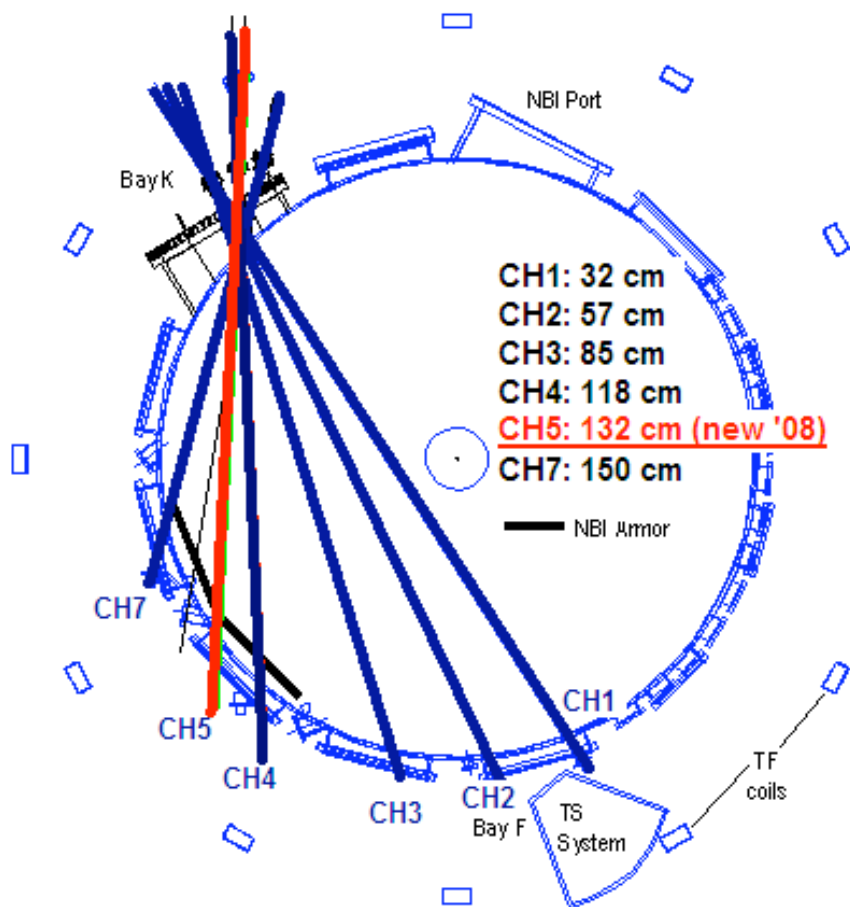
Comparison of NSTX Data with Gyro-Center Shift

Turbulence Diffusion

$$D = \frac{2 \tilde{n}}{\pi n} \left(\frac{\tilde{n}}{n} + \frac{\lambda_t}{2L_{\tilde{n}}} \right) \frac{kT_i}{eB}$$

$$\frac{\tilde{n}}{n}$$

Measurement (FIRETIP) vs. Confinement (EFIT)



Comparison of NSTX Data with Gyro-Center Shift on L\H transition and Future Works

- _ Comparison of E_r Measurement (ERD) with Saturation Condition
- _ Comparison of Density Fluctuation Measurements
 - GPI, Reflectometer, etc
- _ SOL Measurement (GCS and cross field transport)
- _ Neutral Density Profile
 - Calculation, Direct Measurement
- _ Simulation Study with Gyro-Center Shift

