Scalings for cross-field edge plasma transport

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Motivation

- Characterize parametric dependence of anomalous plasma convective velocity V_{convec} and and diffusivity $D_{\perp}$ in the SOL for L and H modes on NSTX.

- Detailed cross-machine (DIII-D, C-Mod, NSTX, ASDEX, MAST, CDXU) comparison

- Compare with analytical theory

- Develop a scaling for V_{convec} and $D\perp$ in the SOL

- Extrapolation to larger tokamaks (JET, ITER)

Far-SOL Vconv dependencies deduced from cross-machine comparison based on UEDGE simulation

$V_{conv} \sim (<ne>)^{\alpha n}$, $\alpha_n \approx 1\text{-}2$

This dependence supports the view that fast radial convection may be a cause for density limit.

$V_{conv} \sim 1/B^{\alpha b}$, $\alpha_b \approx 1\text{-}2$

This dependence features the ExB origin of cross-field transport

$V_{conv} \sim Ti^{\alpha t}$, $\alpha_b \approx 1\text{-}2$

Usually, Ti >Te in SOL of tokamaks.The Ti profile should be properly measured.

However, the "global" parameters enter a scaling in combination. This should be studied.

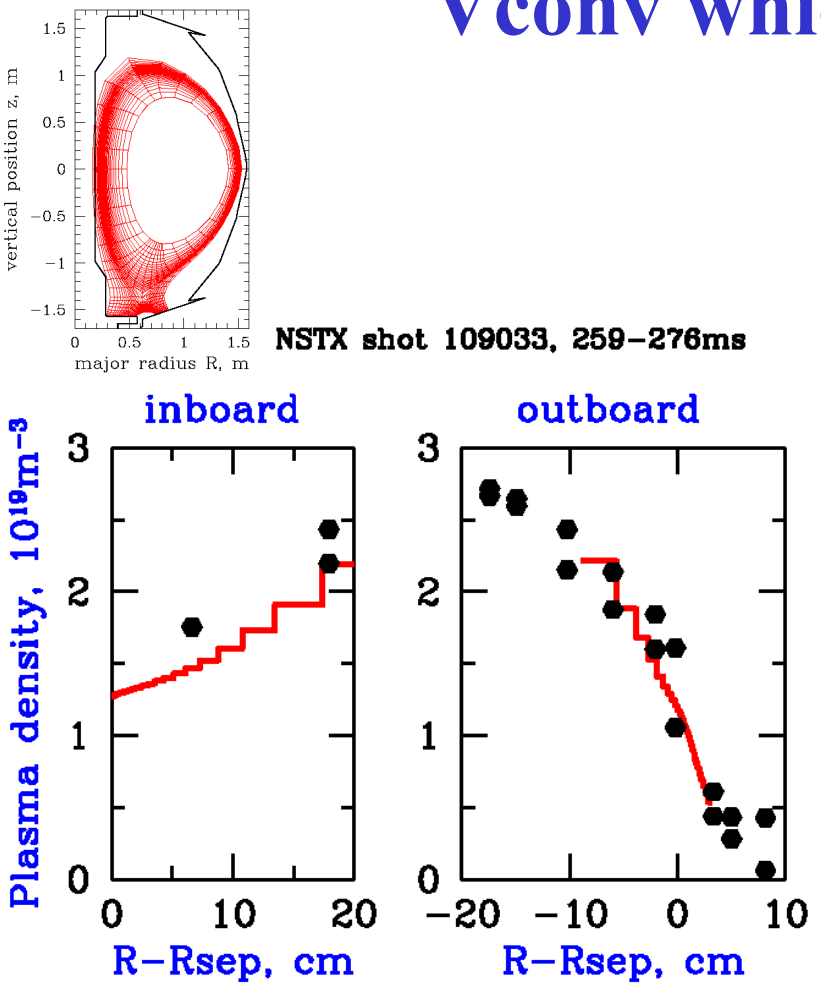
Approach

Scalings for anomalous V_{convec} and $D_{\perp}$ will be derived from matching the NSTX intermittency and recycling data with UEDGE and turbulence codes.

Experiment

A series of well diagnosed discharges is required in L and H modes with varying B, q, A, and edge plasma parameters in a variety of fueling gases: H, D, and He.

Important features of NSTX edge plasma are well reproduced with UEDGE using D, χ, and Vconv which vary radially



1) Intense gas puff at inner mid-plane provides deep core plasma fueling at the rate higher than NBI fueling rate

2) Strong in/out asymmetry in radial plasma profiles and in plasma particle/heat flows

3) Far-SOL shoulders and large mid-plane pressure indicative of main chamber recycling

In low-B NSTX, both diffusive and convective transports are strong.

The following transport parameters are inferred from matching experimental data with UEDGE code: D=1-4 m^2/s χ=10-12 m^2/s Vconv(separatrix)=40 m/s Vconv(wall)=140 m/s