High plasma current case (Ip=700KA): $\Delta V_{tor} < 0$
C-Mod Experiment Results

- Low plasma current case (Ip=350KA): $\Delta V_{tor} > 0$
Rhostar vs. Poloidal Rhostar in C-Mod

- C-mod Lmode is in the low flow regime
Second derivative of pressure profiles

- L-Mode plasma
- One of the low flow correction terms is from the second order derivative of ion pressure in psi
GS2 results for the ratio of mom. flux to heat flux

- w/o coriolis term and velocity shear term
- $\Pi/Q \sim$ poloidal rho star
- For $\Pi/Q$, Quasilinear agrees with Nonlinear?

![Graph showing the ratio of mom. flux to heat flux](image-url)
- ITG dominant
- $Q^*$ surface $\sim$ constant (Ohmic)
- Magnetic shear increasing in radius

**Q/Q\_GB and Pi/Pi\_GB**

![Graph showing Q/Q\_GB and Pi/Pi\_GB](image_url)
Symmetry breaking of Pi/Q in kx

- Shift of the Pi/Q line in kx determines Mom. Flux
- What determines the slope and the shift of Pi/Q?
- Linear GS2 results (Cyclone case with an artificial d2P/dpsi2<0)

<without low flow correction>  <with low flow correction>

![Graphs showing the shift and symmetry breaking of Pi/Q in kx](image-url)
Linear GS2 result

- **w/o lowflow**

- **w/ lowflow**

- Q(left) and Pi/Q(right) w/ lowflow for a peak ky=0.5

\[ \text{flux with } k_x \text{ and } k_y = 0.5 \]

\[ \text{normalized heat flux} \]

\[ \text{parmom/heat flux} \]
Nonlinear GS2 result

- **w/o lowflow**

- **w/o lowflow**

- **Q(left) and Pi/Q(right)**
  w/ lowflow for a peak ky=0.5
Correlation between parallel heat flow to mom. flux

- $u_\parallel > 0 \ , \ q_\parallel > 0$
- Intuitive sign of parallel flow diffusion
  
  $$-nm\chi \frac{\partial (u_\parallel)}{\partial r}$$
- The effect of parallel heat flow

\[
u_\parallel = \frac{1}{n} \int dv^3 v_\parallel h_{NC}^1 \quad q_\parallel = \left\{ \int dv^3 \frac{1}{2} v^2 v_\parallel h_{NC}^1 - \frac{5}{2} v_t^2 u_\parallel \right\}
\]
Parallel heat flow gradient induces mom. flux

- Assume \( D_{hot} > D_{cold} \)
- For a case of \( \frac{\partial q}{\partial \psi} > 0 \), it can result in \( \Pi < 0 \)
Parallel heat flow gradient induces mom. flux

- Assume $D_{hot} > D_{cold}$
- For a case of $\frac{\partial q_{\parallel}}{\partial \psi} > 0$, it can result in $\Pi < 0$
Parallel heat flow gradient induces mom. flux

• Assume $D_{hot} > D_{cold}$
• For a case of $\frac{\partial q_{||}}{\partial \psi} > 0$, it can result in $\Pi < 0$