1. Motivation

- Fast parallel flows (z > Mach 0.6) have been seen in the main chamber SOL of many tokamaks [1-4], DIII-D, Tore Supra, JET, TFTR.
- There is consensus that such strong parallel flows could affect:
  - Impurity transport in SOL
  - Impurity concentration at the separatrix
  - Balance of net ionization between inner/out divertor.

2. Background

- A number of mechanisms that might drive strong parallel flows have been suggested, including:
  - Ionization-driven flows
  - Pelasgris-driven ion flows
  - Balancing transport

3. Experiment

- Measure parallel and cross-field flows with a Mach probe above outer limits in C-Mod
- Parallel flow: Mach probe (East-West electrodes)
- Poloidal flow:
  - Phase velocity of fluctuations: (North/South)
  - EB from Mach probe - plasma potential

4. Methods to Infer Flow

- Parallel Flow
  - Hot-cathode Mach probe model [8]

- ExB Flow from Probe-Sheath Potential
  - Short dipole, 250 Gauss, is correct for secondary emissions from tungsten

- ExB Flow from Fluctuation Phase Velocity
  - Correlation of Velocities * , 2 mm into SOL

5. Typical SOL Profiles

- Representative profiles are shown for a series of strong L-mode discharges with different line-averaged Density

6. Dependence of Flow Profiles on Plasma Conditions

- Dependence on B-field Direction

- Dependence on Line-Averaged Density

- Poloidal Components of Velocities: 2 mm into SOL

7. Comparison of Poloidal Flow Components: Does V||/Vφ scale with and cancel VExB?

8. Magnitude of Net Poloidal Flow, Normalized to Electron Diamagnetic Velocity

The residual poloidal flow (guiding center flow) can be quantified in terms of the electron diamagnetic direction, in analogy to Eq. (2).

9. Summary/Conclusions

- Fast parallel flows (z > Mach 0.6) are measured in the main chamber SOL of many tokamaks.
- Vφ profiles peaks in SOL (z > 2 mm) are observed in tokamaks.
- Vφ reverses nearly symmetrically with B
- V|| decreases with increasing B0

- Cross-field flow (VExB) is inferred by two methods:
  - Phase Velocity (Vφ)
  - Probe-Sheath Potential (Vp)

- Vφ scales similarly to V||, net poloidal flow is enhanced if Tphi and ExB are included in Dphi
- Pure poloidal rotation of guiding centers

- Vφ does not scale on z: residual poloidal flow in the electron diamagnetic direction is quantified, can be compared to the electron diamagnetic velocity

We are presently investigating the use of "impact probe" dispersion patterns to obtain independent measurements of parallel and cross-field flows. See paper P-216.