Investigating momentum transport (and torque sources?) in spherical tokamaks

- Rotation profile important; STs provide unique test of transport theory (low R/a, high β, large ρ_*)
- Previous perturbative measurements in NSTX H-mode (w/ 3D fields; NBI steps) suggest the presence of a pinch similar to conventional tokamaks [Solomon, 2008; Kaye, 2009]
- **Coriolis momentum pinch in STs predicted much weaker, even outward, compared to CTs $\rightarrow$ due to low R/a and/or high β impact on mode-symmetry [Guttenfelder, PoP 2016]**

- **New data and analysis from MAST L-mode (at lower β) using 3D field perturbation:**
  - Rotation braking stronger in core than edge (usually stronger in edge of H-modes)
  - Profile similar to NTV torque predicted by IPEC-PENT/GPEC [Park], due to bounce-harmonic resonance
  - Experiments suggest momentum pinch non-negligible, comparable to NSTX H-mode & CTs
  - Predicted quasi-linear pinch remains small, like NSTX H-mode cases
  - Predicted pinch also small from local non-linear L-mode sims $\rightarrow$ unaffected by NL saturation, E×B shear
  - Developing integrated analysis methods to infer T_{NTV}, χ_φ, V_φ & possibly T_{int} – e.g. allowing for $\chi_\varphi(t) \sim \chi_i(t)$ gives fit with V_φ=0 comparable to constant χ_φ, V_φ

- **New GTS simulations [Wang, Ethier] in progress to investigate residual stress (intrinsic torque) due to non-local effects at finite-ρ_* (higher ρ_* in STs useful)**

- Neither NSTX or MAST cases are stationary:
  - **Perturbative experiments would benefit from long, stationary NSTX-U L-mode exp. (XP-1549)**
  - IPEC-PENT predictions predict core-peaked NTV torque in NSTX L-mode
  - **May open up possibility of probing for intrinsic torque (e.g. via beam modulation)**