Gyrokinetic simulations of angular momentum transport and comparisons with measurements

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Understanding angular momentum transport is important for creating reliable predictions of rotation in fusion reactors which are expected to have negligible applied torque. The GYRO gyrokinetic code [1] is being used to simulate turbulent-driven energy, angular momentum, and species flows. Recent GYRO simulations of profiles of angular momentum flows in JET L-mode plasmas with low $\beta_n$ are in approximate agreement with measurements [2]. Also recent GYRO simulations have been performed for a well-matched pair of TFTR supershots, one with D plasma and the other with DT. These are especially interesting since they exhibit a very clear and strong isotopic scaling of $\chi_i$. The simulated energy and angular momentum transport profiles for both are high by a factor of 2-3. Comparisons of GYRO simulations with results from TRANSP analysis are shown below. We find $\chi_{i,\text{tot}}$ slightly larger than $\chi_{i,\text{mom}}$.

We are using the same techniques to study angular momentum flows in DIII-D plasmas. The plasmas studied include Ohmic and ECCH plasmas probed with NBI blips [3]. These results help understand the intrinsic rotation seen in various experiments.

The method used in GYRO for simulating profiles of the angular momentum flow is to compute the drive from the measured $\nabla(v_{tor})$, and the flow from moments of the distributions of the kinetic ion species. The GYRO code is being upgraded to include a number of improvements [4]:

1) The diffusive contributions to $\chi_\phi$ in the parallel and perpendicular directions and the convective contributions will be written separately.
2) The $v_{i,\phi}$ contribution to the curvature drift will be added.

We plan to discuss effects of these improvements on the simulations.

We wish to thank the US Department of Energy for supporting this research.