Cross-Machine, Multi-Plasma Validation of TGLF on Alcator C-Mod and ASDEX Upgrade

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The turbulent transport code TGLF [1] is validated using a consistent set of validation constraints on 10 plasma discharges from Alcator C-Mod and ASDEX Upgrade. Traditional turbulent transport validation studies tend to focus in depth on a single plasma discharge on one machine, often due to the large computational resources required for gyrokinetic simulations [2]. The availability of increasingly accurate reduced models such as TGLF, and the ability to launch many runs in parallel using a framework such as VITALS [3], however, enables another approach to validation studies. This study employs a common methodology and set of validation constraints (heat fluxes, electron temperature fluctuations [4, 5], and perturbative diffusivity [6]) to validate TGLF on 10 plasma discharges on two machines. In particular, the study is motivated by recent results on Alcator C-Mod and ASDEX Upgrade suggesting that multi-scale gyrokinetic models are absolutely required to accurately model some plasmas, while ion-scale models are entirely sufficient for other plasmas [7, 8]. To that end, TGLF is validated in both ion-scale and multi-scale configurations, in order to investigate when multi-scale effects are necessary to find agreement with experiment. Multi-scale simulations are shown to agree well with experiment in all cases, while ion-scale simulations agree only for some plasmas. Results so far suggest that ion-scale simulations perform best in cases where turbulence is most strongly driven.

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