Simulating thermal energy transport in MAST using Trinity and GS2

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We present simulations of thermal energy transport in MAST based on local gyrokinetic flux tubes at multiple flux surfaces across the plasma, using the GS2 gyrokinetic code within the Trinity transport solver to calculate corresponding temperature profiles. This multiscale framework averages microturbulent energy fluxes over intermediate space and time scales that are smaller than the background gradient length and confinement time scales characteristic of the transport evolution, thereby permitting a much coarser resolution of the transport grid in both space and time.

Experimental evidence indicates that anomalous ion transport in MAST is often substantially suppressed. Our linear simulations support the paradigm that flow shear stabilizes electrostatic modes at ion scales. In our flux tubes we model only electron scales, reducing the computational resource requirements to the order of 10^4 core hours per transport iteration. Neoclassical transport is added to the ion channel.

Our results for the shot considered show good agreement with the experimental electron temperature gradient profile in the outer part of the core plasma. In the inner part, where the magnetic shear is negative, the modelled electron energy flux is suppressed relative to experiment, consistent with the linear stability of electrostatic modes found on a flux surface in this region.

The GS2 and Trinity codes already have the capability to include further physics in future studies, including magnetic fluctuations, particle transport and momentum transport.

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