ACTION AT DISTANCE AND BOHM SCALING OF TURBULENCE IN TOKAMAKS

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Recent transport experiments in tokamaks have suggested the concept of "action at distance" in which the local turbulence depends on gradients at a distance larger than the correlation length. Furthermore, the scaling of the ion thermal diffusivity is not always consistent with local gyro-Bohm-like transport but rather scales worse than Bohm-like. We attempt to reconcile these observations with simplified numerical simulations of toroidal ion temperature gradient (ITG) mode turbulence using a fast 2-D inhomogeneous full radius turbulence code. It is found that action at a distance is possible but only at weak damping rates since the propagation range is given simply by the curvature drift group velocity divided by the average damping rate. The correlation lengths always scale linearly with the gyroradius. We find that Bohm scaling or worse is possible when we are close to the ITG threshold and the radial modes keep the turbulence level small enough to avoid destroying the slow to form global eigenmodes. In contrast to local ITG ballooning modes, the global eigenmode growth rates decrease with increasing gyroradius from the effect of larger diamagnetic rotational shear. This behavior results in an increase of the correlation time with increassing gyroradius, when the gradients are close to the thresholds. Thus at sufficiently large relative gyroradius, the breaking of gyroBohm scaling can result from increased stability not mixing length.