Heuristic theory of nonlocally broken gyroBohm scaling

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Abstract. Global gyrokinetic simulations of ion temperature gradient turbulent transport with piecewise flat profiles are given to illustrate the breaking of gyroBohm scaling by a nonlocal mechanism. The nonlocal drainage of the turbulence from unstable regions spreading into stable (or less unstable) regions breaks the gyroBohm scaling toward Bohm in unstable regions and toward super-gyroBohm in stable (or less unstable) regions. A heuristic model for this nonlocal process is formulated in terms of a nonlocal growth rate resulting from a locally weighted radial average of the local linear ballooning mode growth rate. A nonlocality length L measured in ion gyroradii provides the exponential scale for the local weighting. The nonlocal growth rate can be incorporated into a local gyroBohm-scaled transport model in place of the local growth rate. The resulting nonlocal transport model will provide some transport in stable regions. A heuristic theory of this nonlocal transport mechanism based on the partial formation of global modes in toroidal geometry is detailed. The theory argues that the nonlocality length L increases with relative gyroradius and decreases with the linear growth rate.

PACS: 52.35Ra, 52.25Fi, 52.30Gz, 52.55Fa, 52.65Ti