Global-local schemes for gyrokinetic simulations

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Local (flux-tube) simulation

*the good:*

✔ spectral accuracy in the perpendicular dynamics
✔ gyro-averaging is simple

*the bad:*

✗ simple background profiles
✗ boundary conditions sensible only in a statistical sense

Global simulation

*the good:*

✔ arbitrary profile variation
✔ large-scale coherent structures

*the bad:*

✗ lose spectral accuracy in radial direction
✗ Dirichlet BCs typical – not much better than periodic BCs
IDEA: Use additional flux-tube simulations at different radial locations to determine the boundary conditions in the ‘main’ simulation.

See Parra & Barnes, PPCF 57 (2015) for motivation.
METHOD:

$g_-(\psi, \alpha)$  $g_c(\psi, \alpha)$  $g_+(\psi, \alpha)$

boundary region  $\psi$
Figure: Terry-Horton model with identical parameters and different ICs.
Figure: Terry-Horton model with density gradient profile.
Figure: Terry-Horton model with $\text{sech}^2(x/\rho_s)$ density gradient profile.
FUTURE STEPS:

▶ Implement in a gyrokinetic flux-tube code.
▶ Add profiles in pressure and magnetic geometry.
▶ Add finite-$\rho_*$ effects.