stuff about the MRI?

set-up
boundary conditions
parameter range
open questions, etc

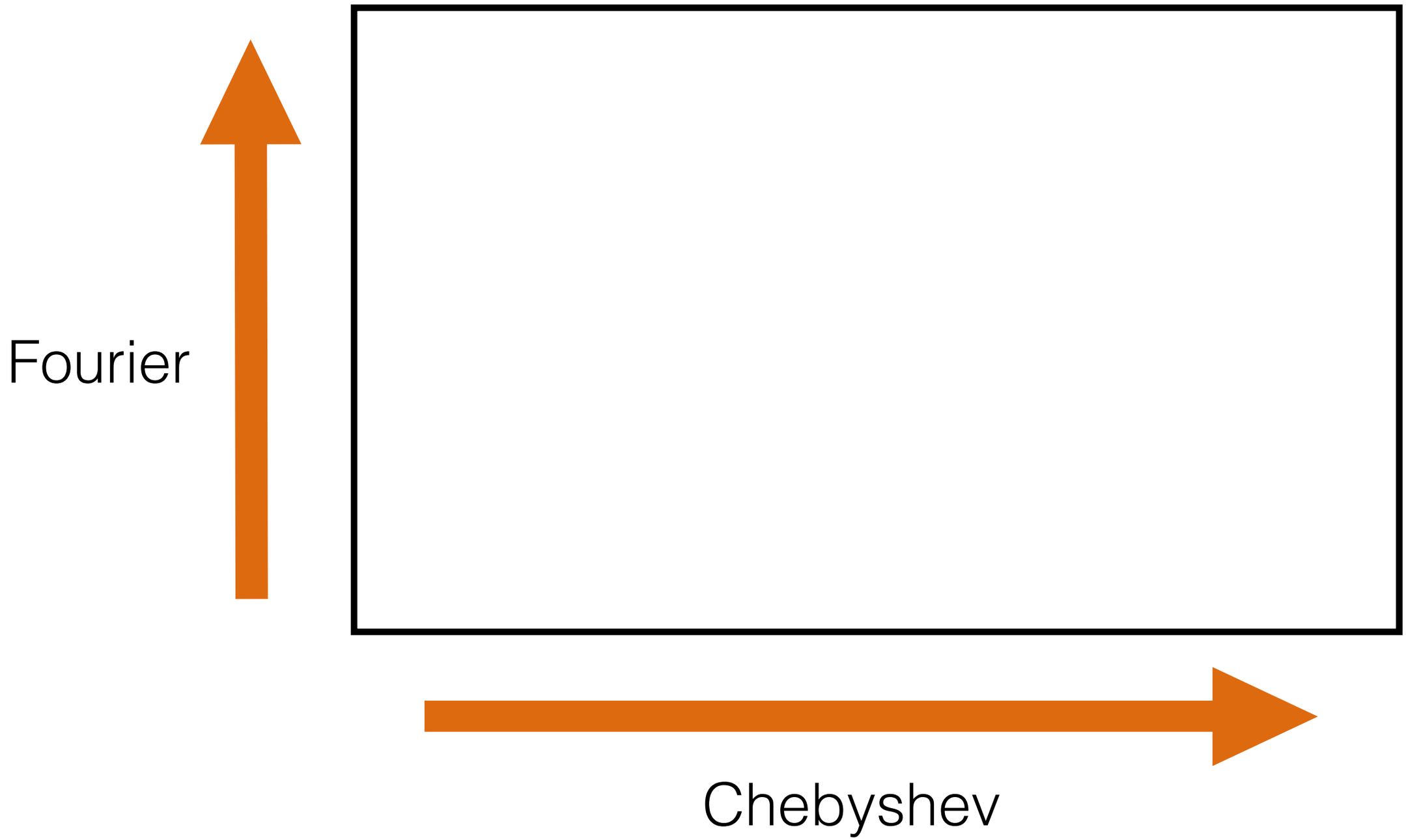
momentum

$$\partial_t \mathbf{u} + \mathbf{u}\cdot\nabla\mathbf{u} = -\frac{1}{\rho}\nabla P - \nabla\Phi + \frac{1}{\rho}(\mathbf{J}\times\mathbf{B}) + \nu\nabla^2\mathbf{u} - 2\boldsymbol{\Omega}\times\mathbf{u} - \boldsymbol{\Omega}\times(\boldsymbol{\Omega}\times\mathbf{r})$$

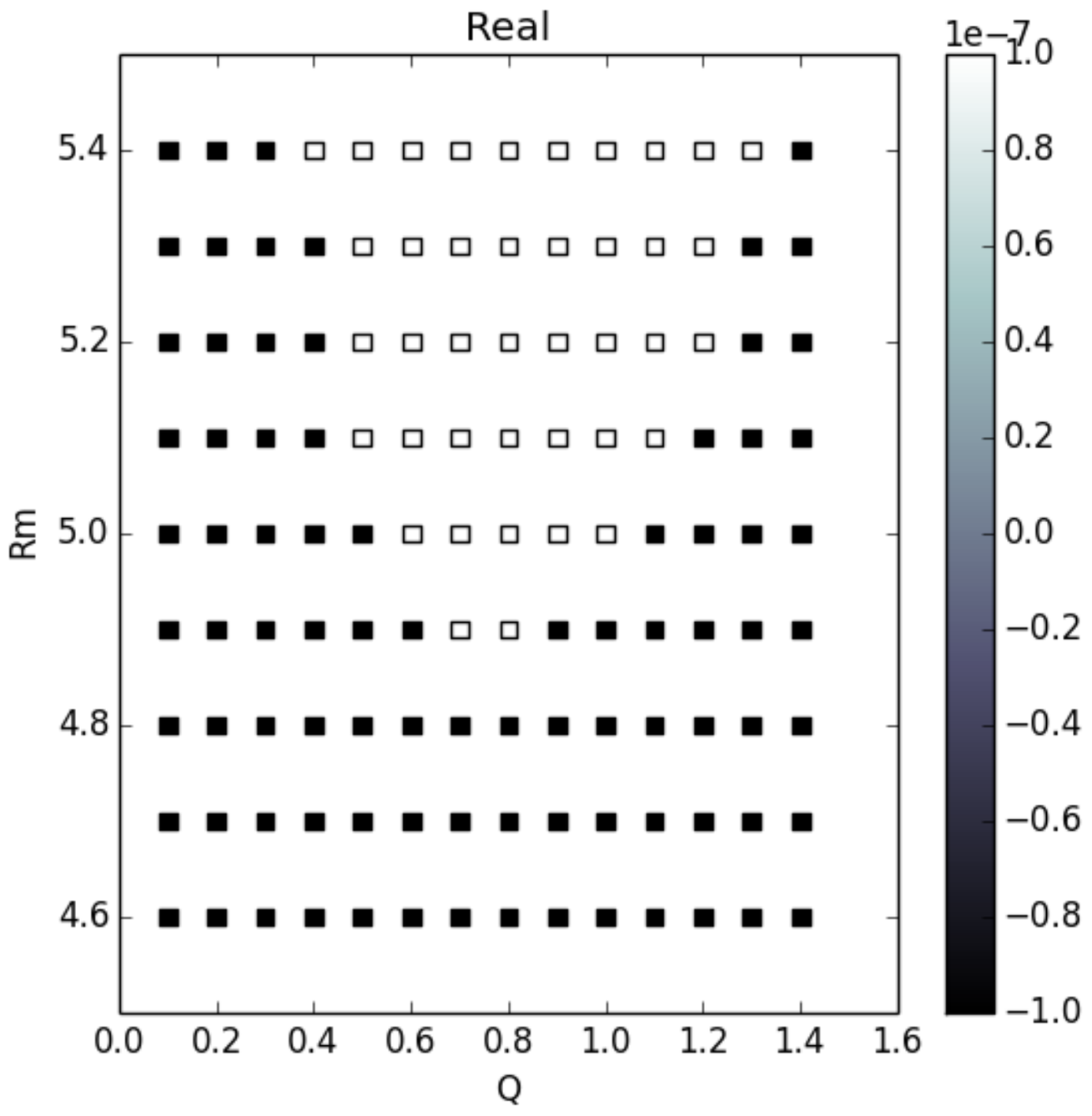
induction

$$\partial_t \mathbf{B} = \nabla\times(\mathbf{u}\times\mathbf{B}) + \eta\nabla^2\mathbf{B}$$

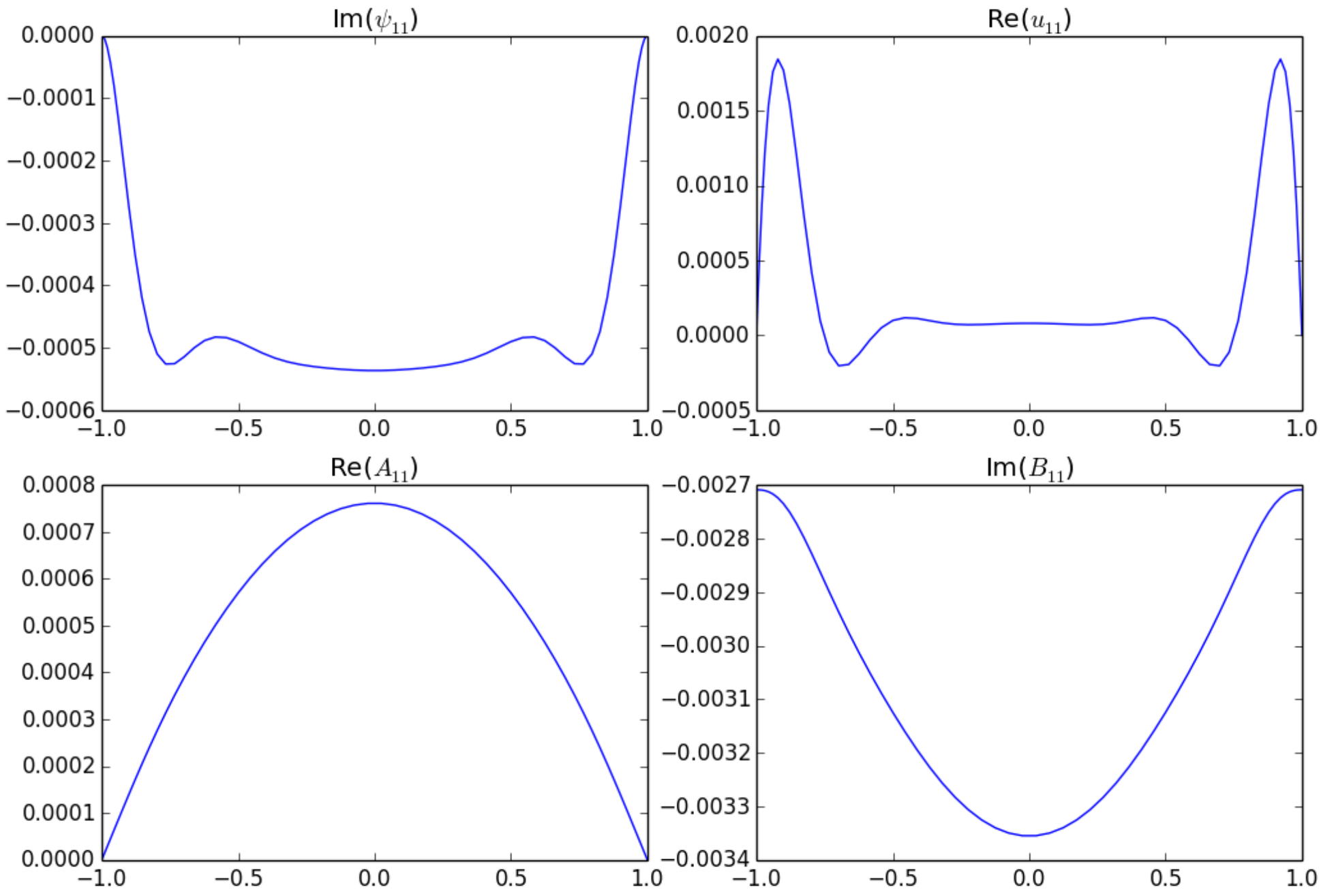
set-up, boundary conditions, dedalus



Weakly nonlinear analysis explores behavior at the margin of instability.



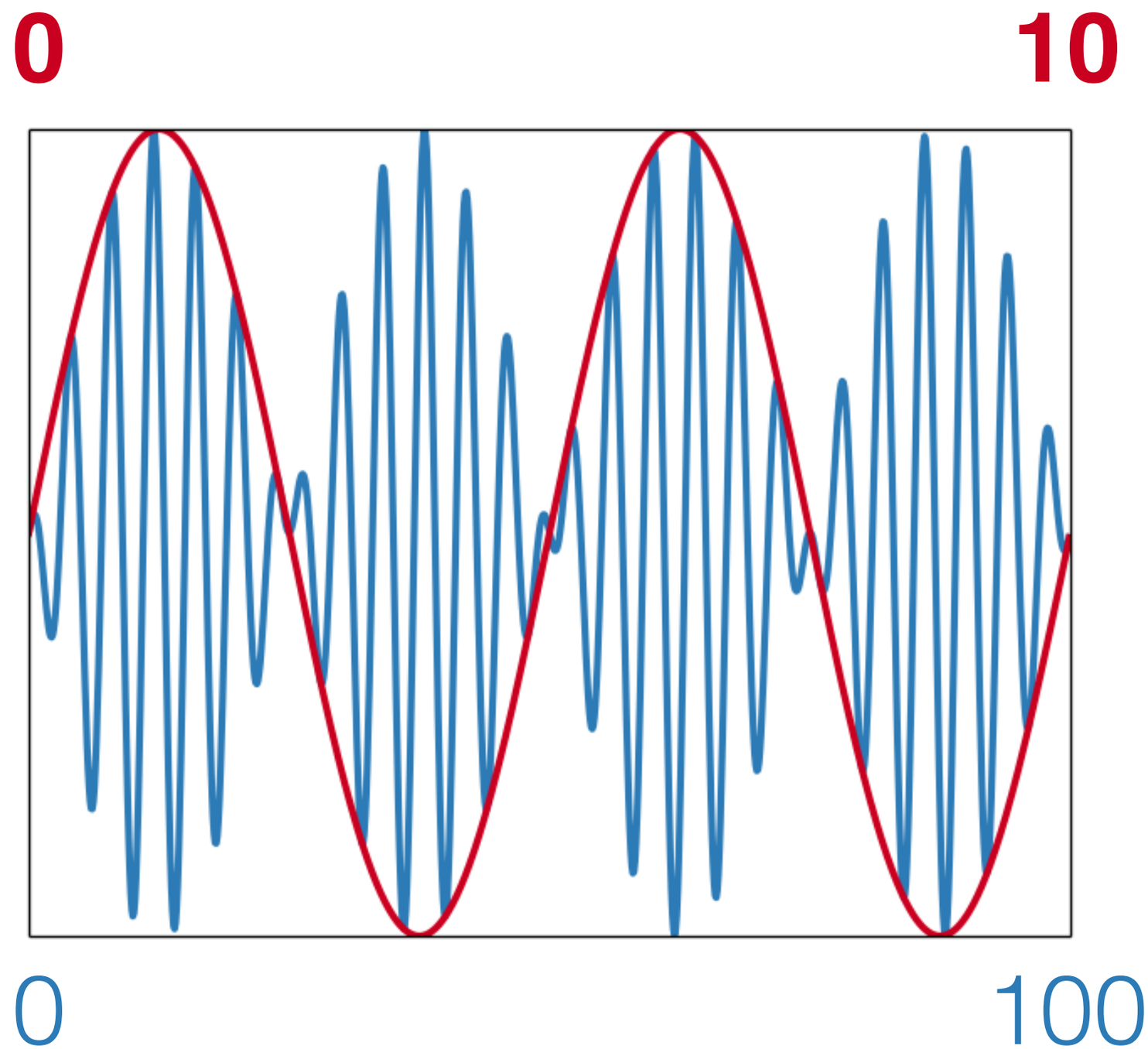
Identify the most unstable mode of the linear MRI.



Tune this mode just over the threshold of instability.

Multiscale analysis tracks the evolution of fast and slow variables.

$$X \equiv \epsilon x$$

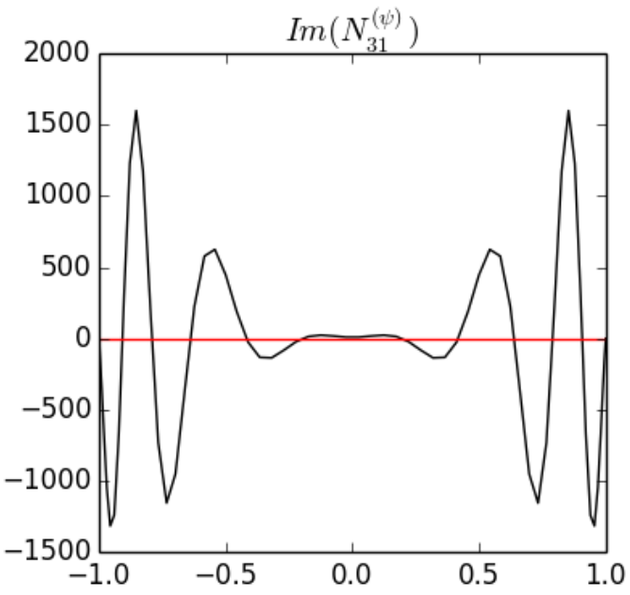


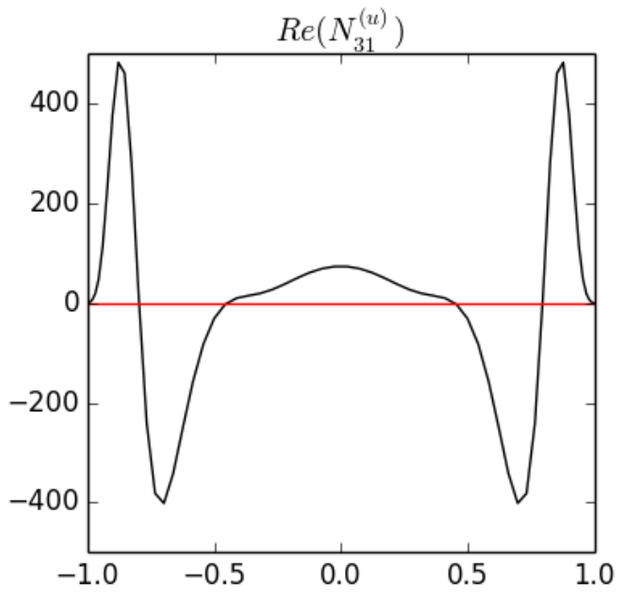
Equations are solved in a matrix formulation.

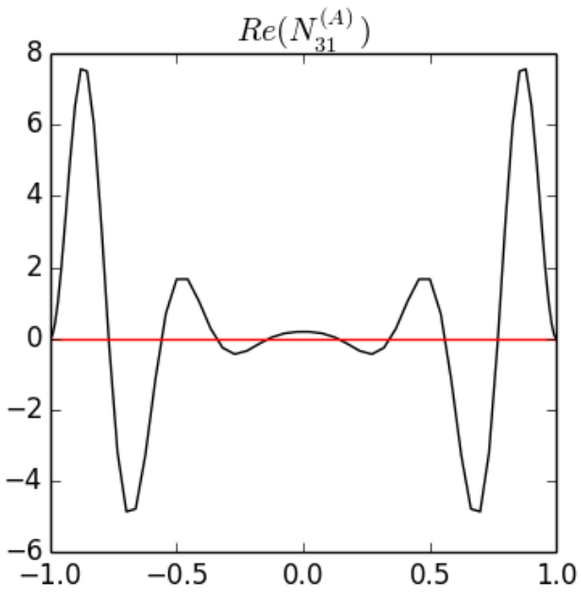
The fluid quantities are expanded in a perturbation series.

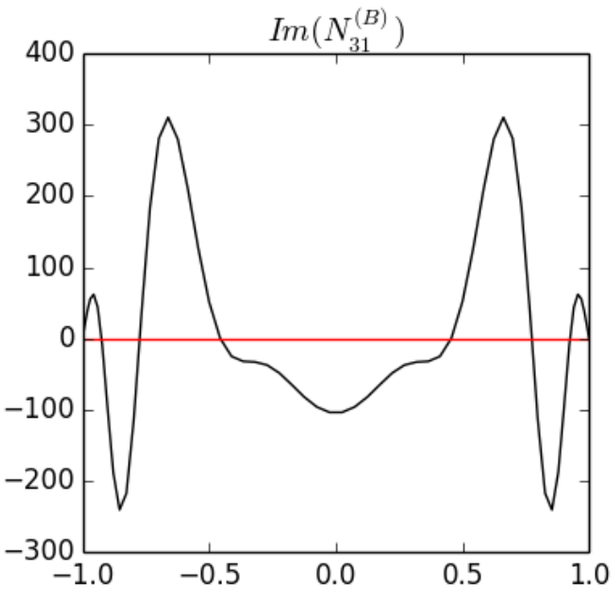
$$\mathbf{V} = \epsilon \mathbf{V_1} + \epsilon^2 \mathbf{V_2} + \epsilon^3 \mathbf{V_3} + ...$$

something about boundary layers?

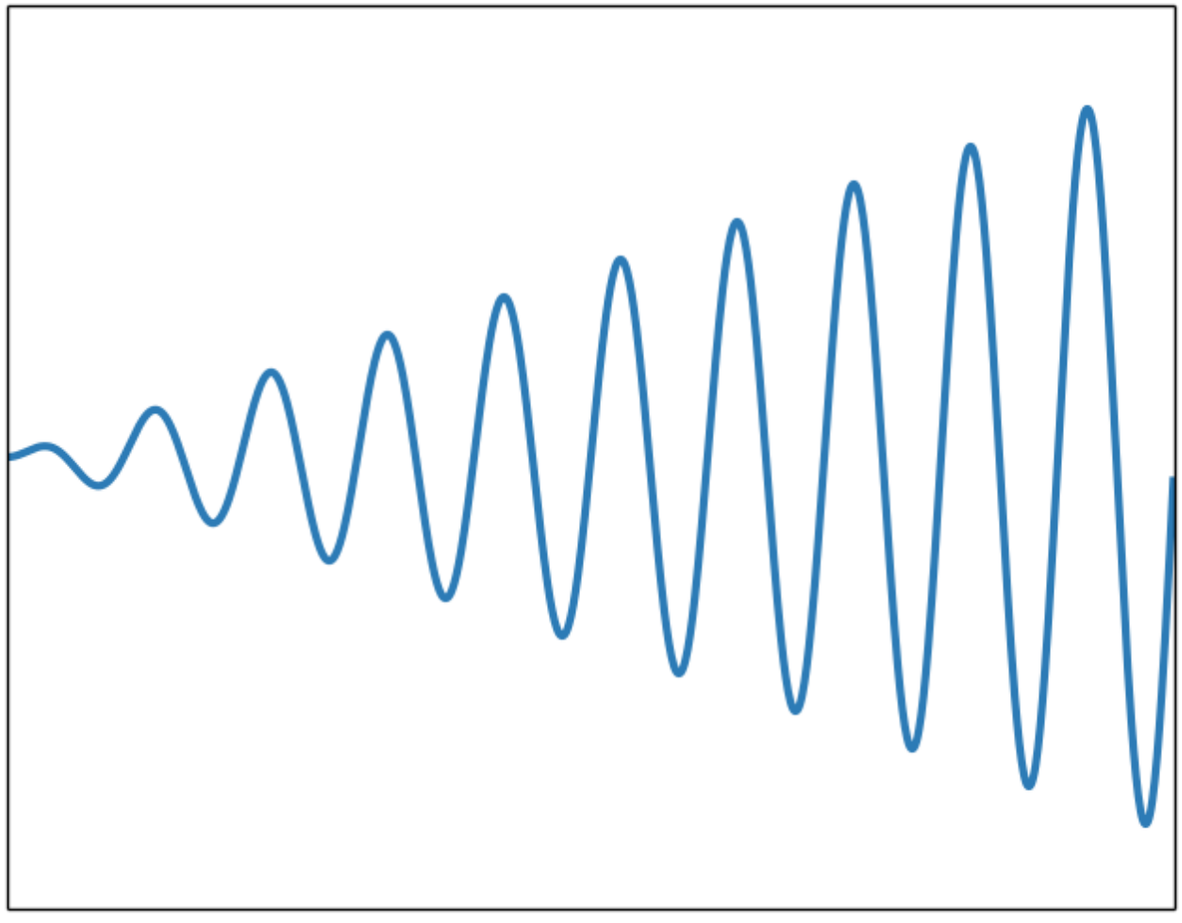








The removal of secular terms yields solvability criteria.



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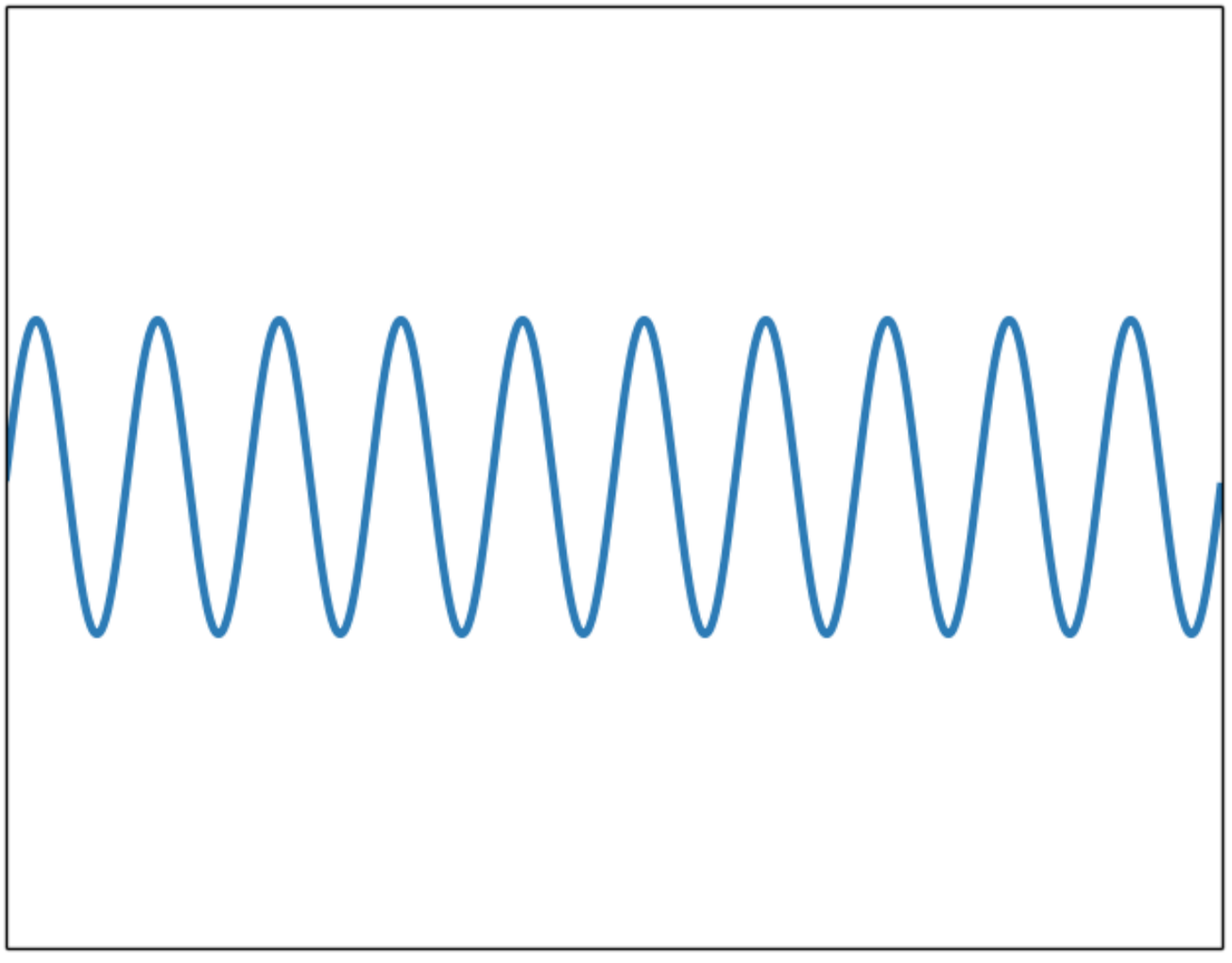
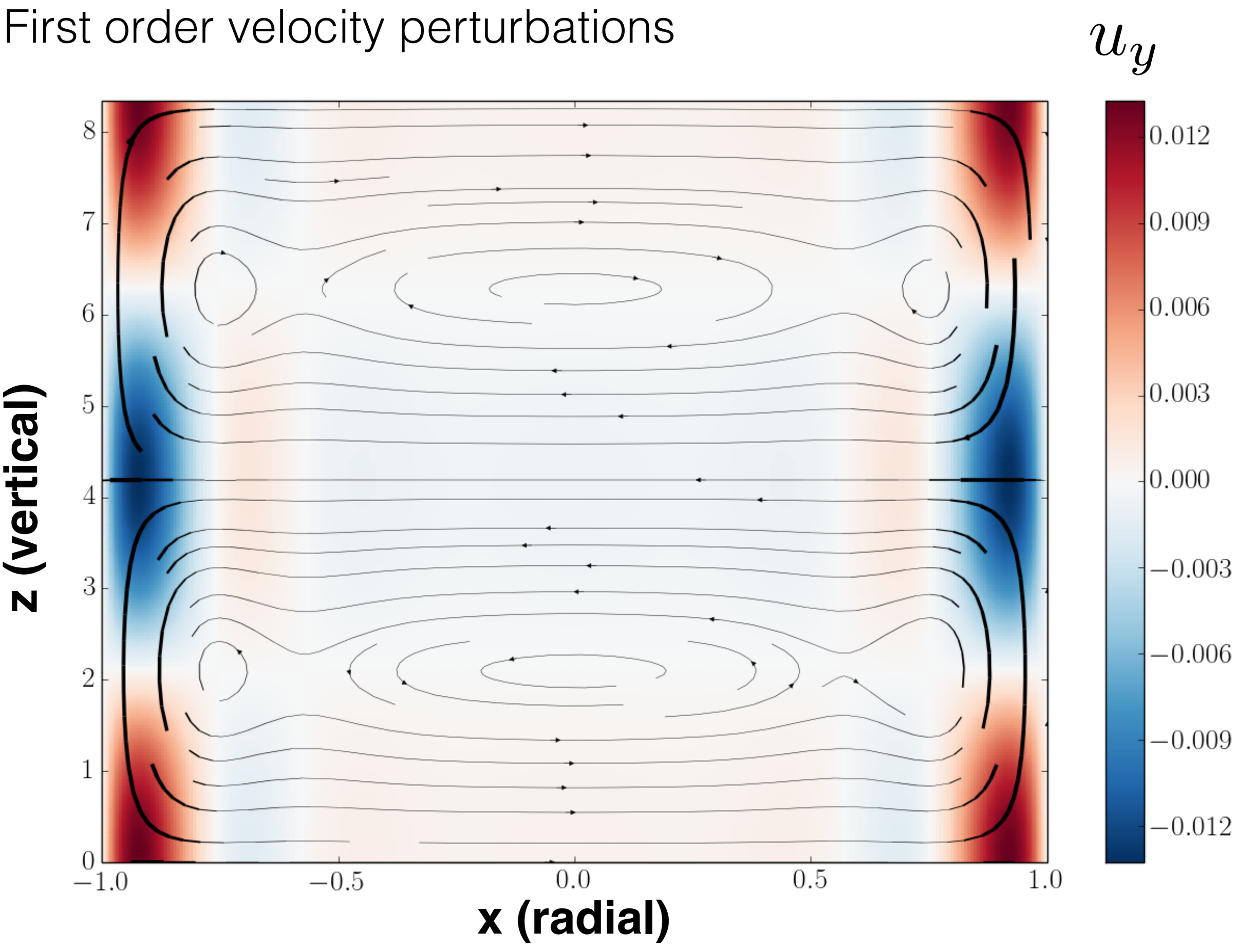
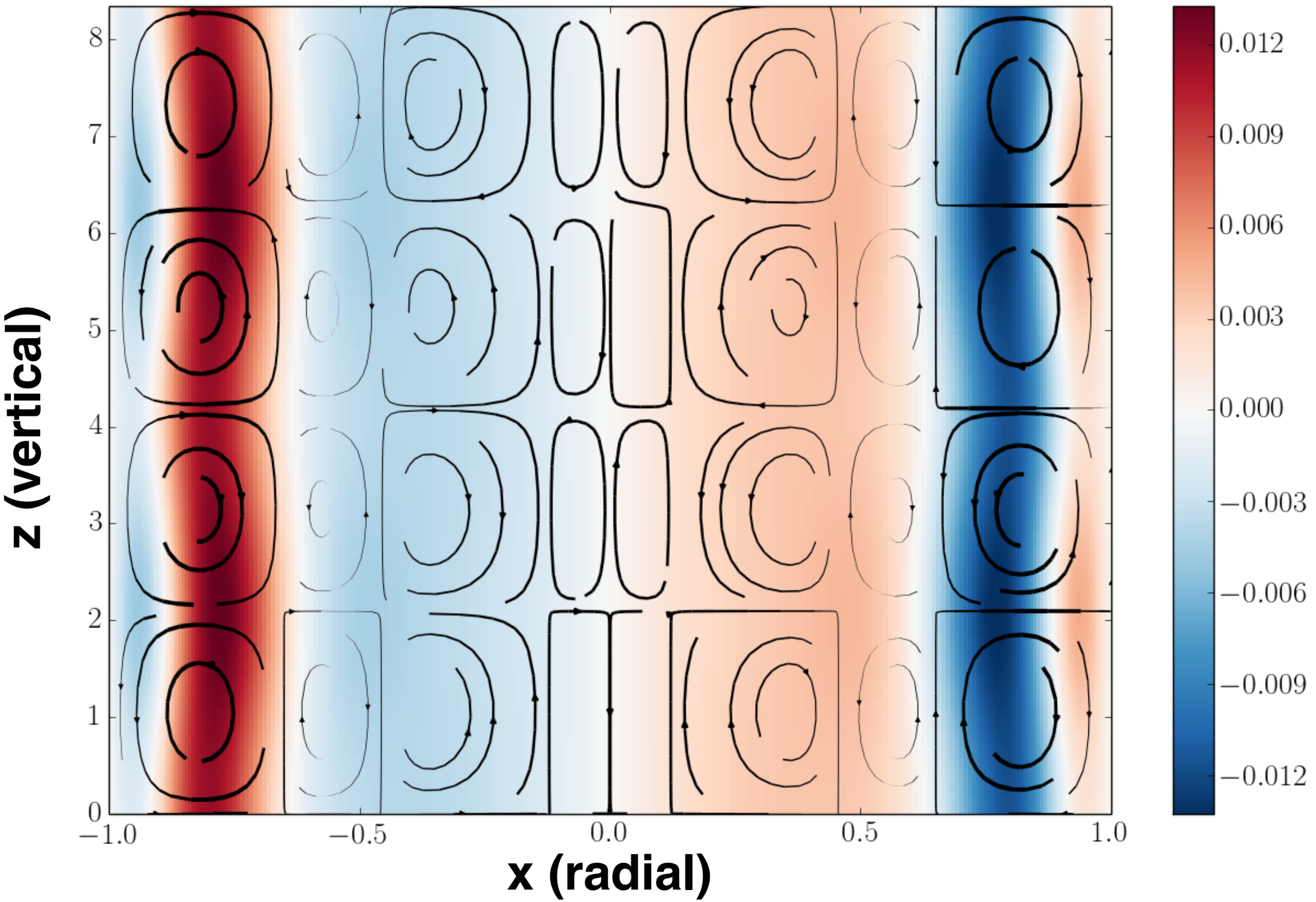


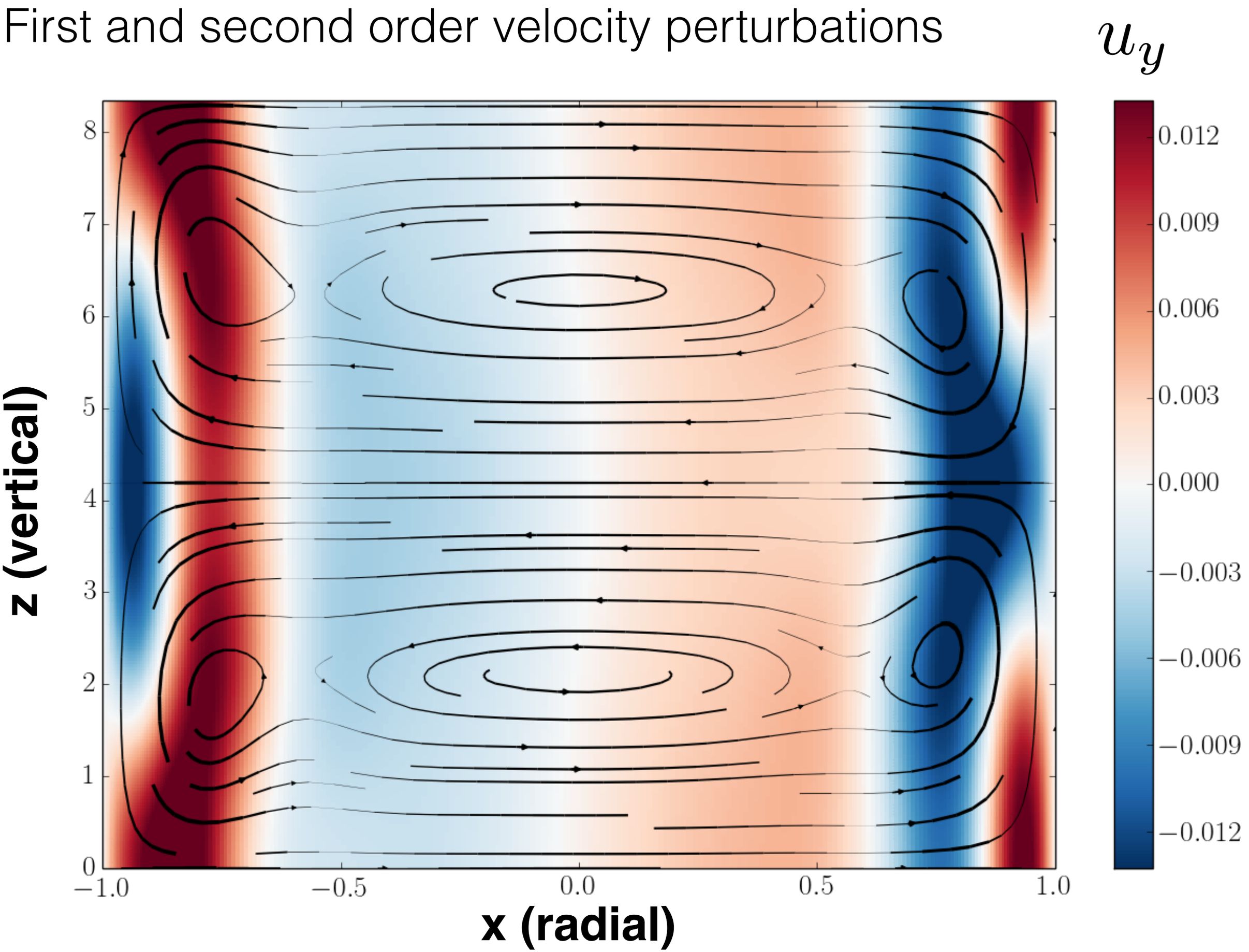
First order velocity perturbations



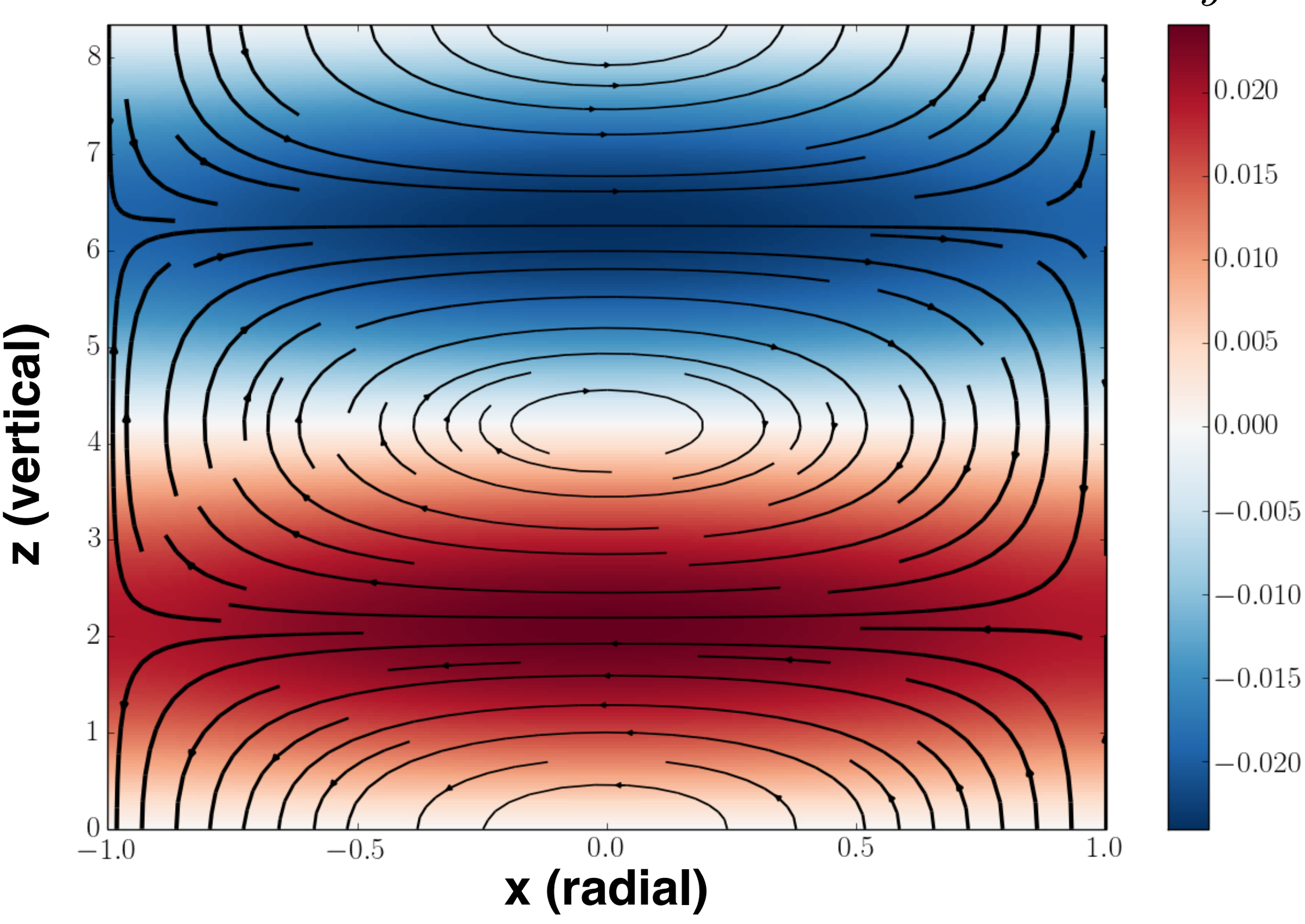
Second order velocity perturbations



First and second order velocity perturbations

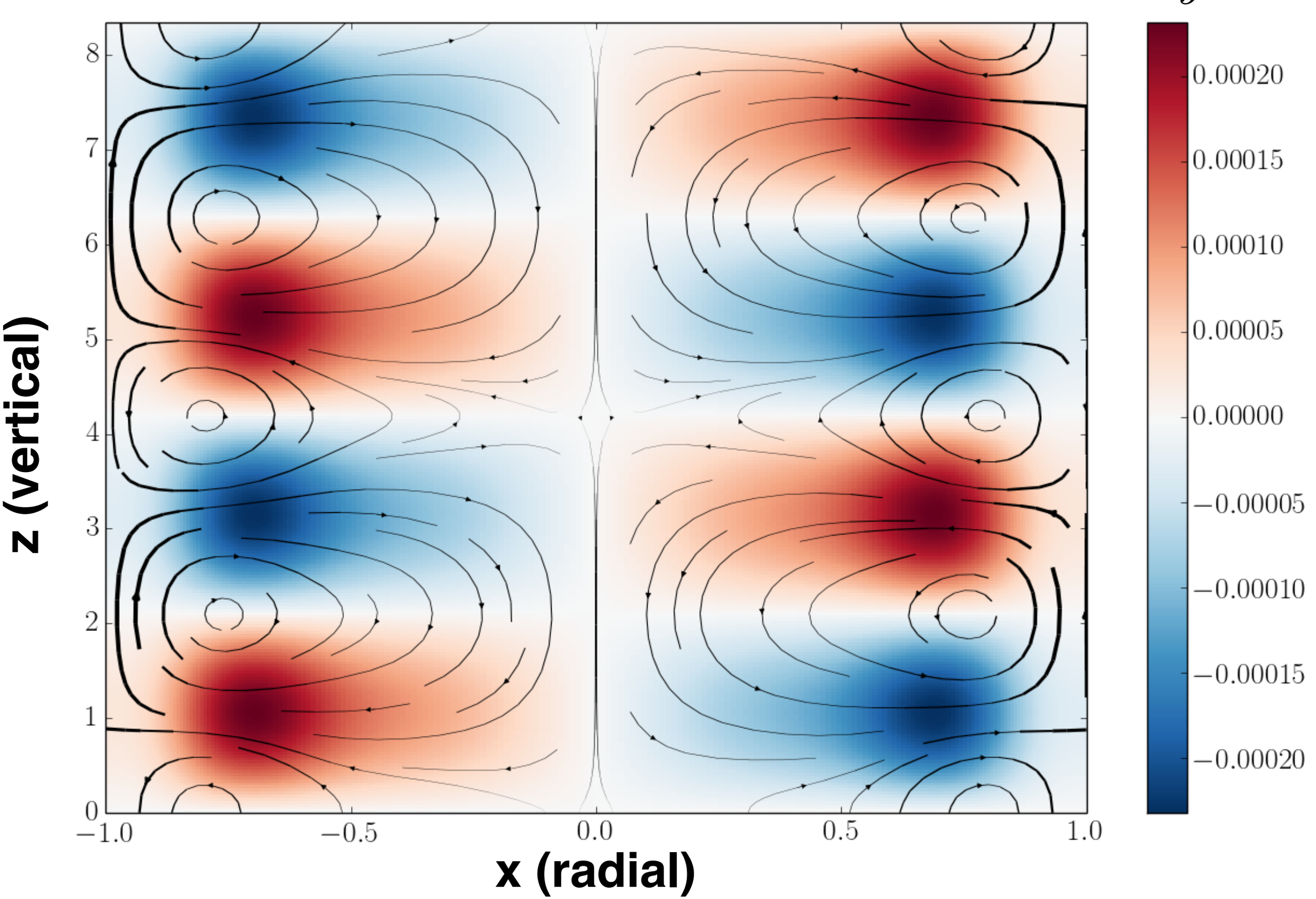


First order magnetic field perturbations

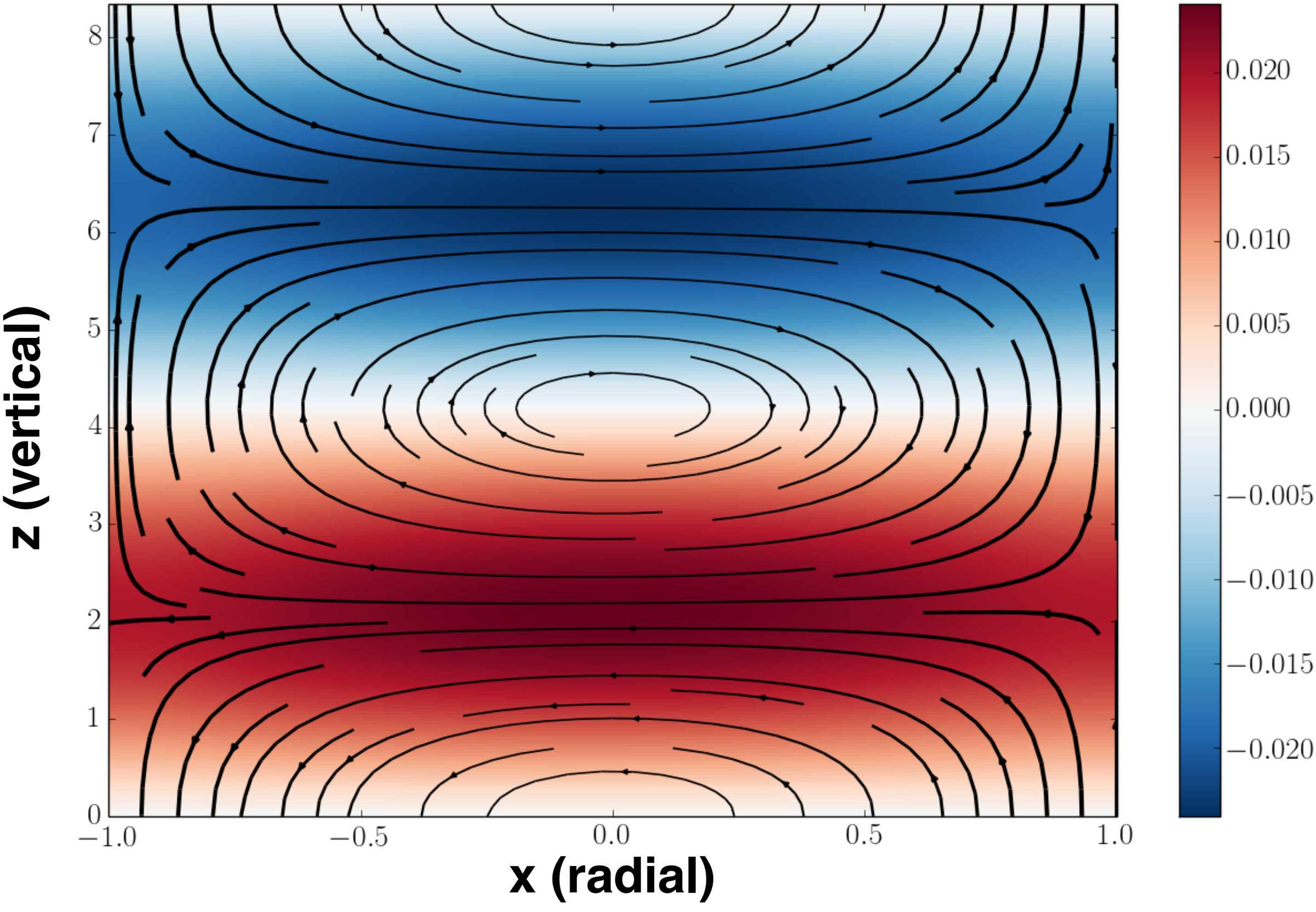


Second order magnetic field perturbations

two OOM smaller!



First and second order magnetic field perturbations B_y



Future work:

non-thin gap approximation
helical MRI
explore parameter space
comparison to experiment