

Investigating the Dimits shift by external shear flows

Holger Angenent,
Frank Jenko, Rudolf Friedrich

Institute for Theoretical Physics, University of Muenster
IPP Garching

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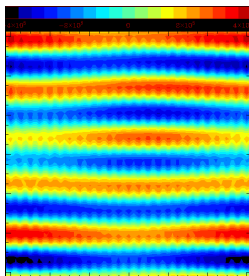
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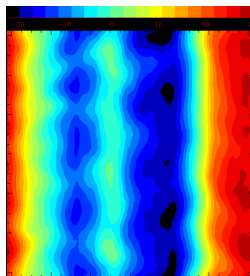
Dimits shift

- Nonlinear upshift of critical temperature for ITG turbulence
- First observed by A. Dimits for a specific set of parameters
- Why does it occur? \Rightarrow Zonal flow induced suppression of turbulence
- Why is it limited? \Rightarrow (Tertiary?) instabilities
- How does it vary with physical parameters?
- Can linear investigations help to understand it?

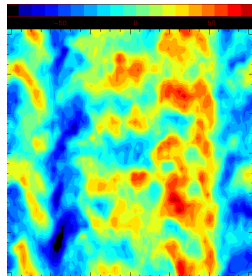
Cascade of instabilities



primary instability
 ⇒ streamer



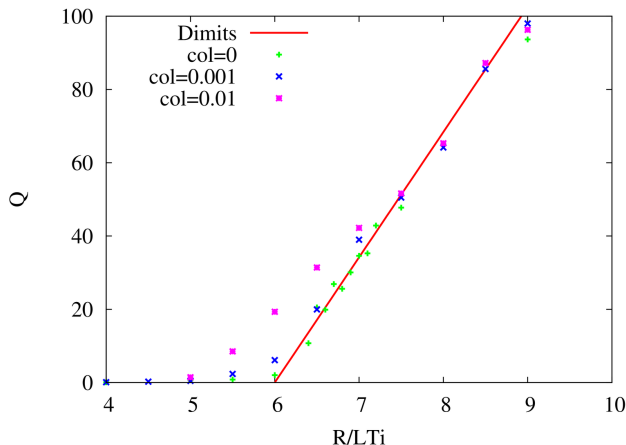
secondary instability
 ⇒ in ITG case
 zonal flows



tertiary instability
 ⇒ slab ITG modes?

Influence of collisions on Dimits shift

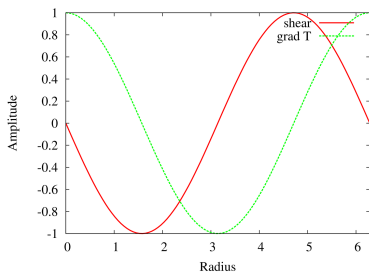
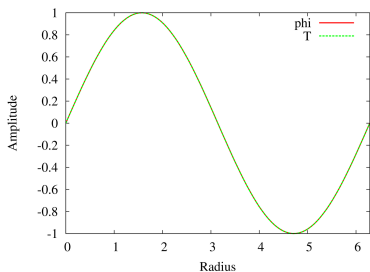
Heat flux in dependence of temperature gradient, collisions lead to linear zonal flow damping, linear threshold at $R/L_T = 3.8$.



Additional shear flows

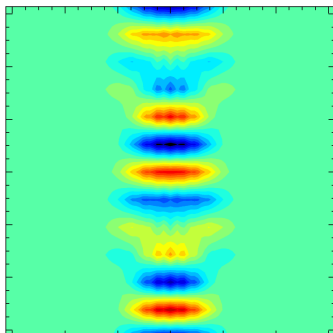
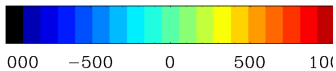
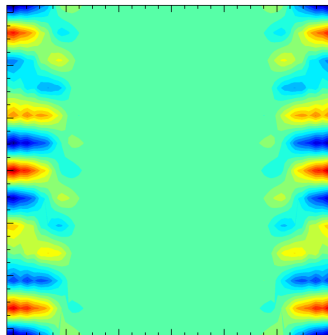
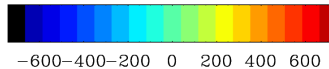
- Put additional zonal components in potential and temperature fields
- Measurement of maximal linear growth rates

Example: Phase shift of 0 between zonal Φ and zonal T



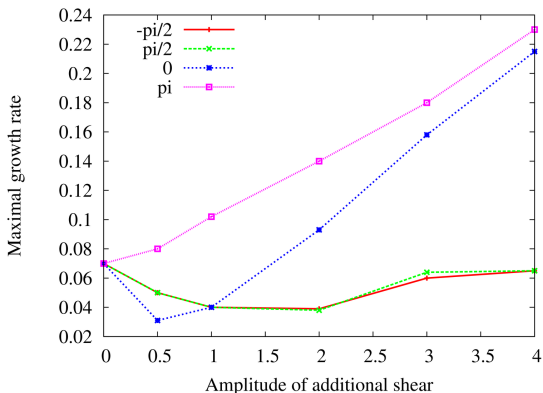
B.N.Rogers, W.Dorland, M.Kotschenreuther, Phys. Rev. Lett. 85, 25 (2000)

Location of maxima

 π 

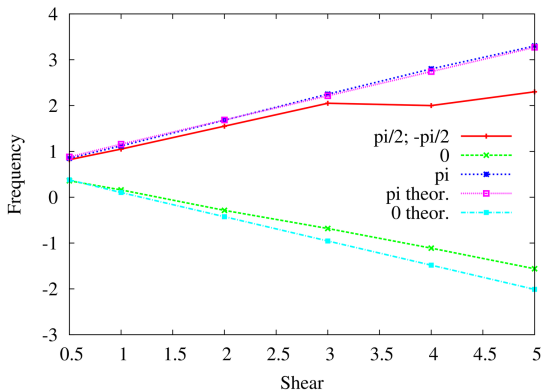
0

Maximal linear growth rates



Shear with $k_x=0,1$; with higher shearing rate, growth rates show strong dependence of phase shift

Frequencies



Frequencies of instable modes with different phase shifts.

Open questions

- Can nonlinear behavior be explained with phase shift between shear flows?
- Nature of tertiary instability: Slab ITG mode?