Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Nonlinear instabilities in parallel shear flows of viscoelastic fluids ALEXANDER MOROZOV, WIM VAN SAARLOOS, Instituut-Lorentz, Leiden Univ. — Newtonian fluids are known to exhibit turbulent behaviour at large enough Reynolds numbers. Recently, it has been discovered that flows of visco-elastic fluids in simple geometries become chaotic at arbitrary low Reynolds numbers (the so-called "elastic turbulence"). When elastic stresses become large enough, laminar flows lose their stability and become turbulent. However, a little is known about the exact nature of this instability. Model calculations reveal that for some geometries the basic flow can become linearly unstable, while for the others it stays linearly stable for any value of the elastic stresses. Here we present a non-linear mechanism of the flow instability: independently of the presence or absence of the linear instability, the finite-amplitude disturbances can result in flow destabilization. We calculate the onset of this transition for plane Couette and plane Poiseuille flows and show that its sub-critical nature leads to the chaotic regime very close to the onset. We discuss briefly the role of these finite-amplitude solutions in sustaining visco-elastic turbulence.

Wim van Saarloos
Instituut-Lorentz, Leiden Univ.

Date submitted: 12 Aug 2005

Electronic form version 1.4