Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Stability of solution branches in infinite rotating disk flow[1] KEVIN VAN EETEN, JOHN VAN DER SCHAAF, GERT-JAN VAN HEIJST, JAAP SCHOUTEN, Eindhoven University of Technology — The stability of steady solutions of the Navier-Stokes equations for the problem of viscous flow between an infinite rotating disk and an infinite stationary disk is investigated. A random disturbance is applied to five velocity profiles at $t = 0$, after which the disturbance propagation, $\Delta(t)$, defined as the squared difference of the azimuthal velocity at time t with the steady state azimuthal velocity, is determined. From this propagation data, the Lyapunov exponents are obtained as a function of the Reynolds number. It was found that four of the five solution branches (including the Batchelor solution) are Lyapunov stable. The Stewartson solution, on the other hand, was found to have a positive Lyapunov exponent and diverged from its initial state to a Batchelor type of flow. The mechanism with which the non-viscous core obtains its angular momentum during this transition was identified as being dominated by radial convection from larger radii towards the axis of rotation.

[1]The European Research Council (ERC) is gratefully acknowledged for their financial support to this project (ERC Contract No. 227010)

Kevin van Eeten
Eindhoven University of Technology

Date submitted: 03 Jul 2012 Electronic form version 1.4