Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Large scale flow instabilities in rotating flows L. DEL CASTELLO[1], H.J.H. CLERCX, R.R. TRIELING, A. TSINOBER[2] — Background rotation affects the dynamics of fluid flows with a combination of linear and nonlinear effects, according to the relative importance of the Coriolis acceleration compared to the convective and forcing terms in the Navier-Stokes equation. We perform experiments on a turbulent flow ($Re_\lambda \sim 150$) electromagnetically forced in a confined tank put on a rotating table, and we measure the flow using Particle Tracking Velocimetry. We focus here on the anisotropic effects of rotation at the large scales, and we define the Rossby number $Ro_f = \frac{U_f^2/L}{2\Omega U_f}$ based on the forced velocity scale U_f. With a mild rotation of 0.2 s^{-1} ($Ro_f \sim 1.8$), we observe an enhancement of horizontal and vertical velocity gradients of the large scale flow, but the overall forced flow pattern remains stable. When the rotation is increased to 2.0 s^{-1} ($Ro_f \sim 0.2$), we observe instead the dampening of the velocity gradients at large scales, while the forced flow pattern strongly fluctuates. With a strong rotation of 5.0 s^{-1} ($Ro_f \sim 0.07$), the stability of the forced mean flow structures is finally restored.

[1]Dept. of Physics, Eindhoven University of Technology, P.O.Box 513, 5600MB Eindhoven, The Netherlands
[2]Inst. Math. Sciences and Dept. of Aeronautics, Imperial College London, United Kingdom

L. Del Castello

Date submitted: 31 Jul 2009 Electronic form version 1.4