Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Universal Realizable Anisotropic Prestress (URAPS) Closure for the Reynolds Stress CHARLES PETTY, Michigan State University, KARUNA KOPPULA, Rochester Institute of Technology, ANDRE BENARD, Michigan State University, MSU COLLABORATION — The Reynolds-averaged Navier-Stokes (RANS-) equation for constant property Newtonian fluids is unclosed due to the explicit appearance of the normalized Reynolds (NR-) stress and the turbulent kinetic energy. Clearly, any solution to an NS-closure model must be a non-negative operator. This longstanding problem has recently been addressed by developing a non-negative algebraic mapping of the NR-stress into itself. Consequently, all solutions of the URAPS NR-stress equation are non-negative dyadic-valued linear operators regardless of the class of benchmark flows used to determine closure parameters. Most significantly, unlike the class of Boussinesq closures for the NR-stress, the new theory predicts the redistribution of the turbulent kinetic energy among the three components of the fluctuating velocity field for statistically stationary spanwise rotating channel flows. Furthermore, the URAPS theory also predicts that the Coriolis acceleration causes an anisotropic re-distribution of turbulent kinetic energy among the three components of the fluctuating velocity field in rotating homogeneous decay.

Charles Petty
Michigan State University

Date submitted: 23 Jul 2013 Electronic form version 1.4