Abstract Submitted
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RANS-Equation and the Reynolds Momentum Flux: Homogeneous Decay in a Coriolis Field and a Magnetic Field CHARLES PETTY, Michigan State Univ, ANDRE BENARD, Michigan State University — The Reynolds-averaged Navier-Stokes (RANS-) equation for constant property Newtonian fluids is an exact unclosed equation due to the explicit appearance of the normalized Reynolds stress (NRS) and the turbulent kinetic energy. The NR-stress is a dyadic-valued operator. This operator must be real, symmetric, non-negative, and non-objective (i.e., the eigenvalues depend on the temporal frame-of-reference). These mathematical properties must be satisfied for all turbulent flows in all inertial and non-inertial frames. Karuna S. Koppula (see, Koppula et al., 2009,2011,2013) developed a non-linear algebraic mapping of the NR-stress into itself that satisfies all of the foregoing mathematical properties (URAPS = Universal, Realizable, Anisotropic Prestress). It is noteworthy that the RANS/URAPS closure predicts that the Coriolis acceleration causes an anisotropic re-distribution of turbulent kinetic energy among the three components of the fluctuating velocity field in a rotating homogeneous decay. The effect of the magnetic component associated with the Lorentz field has a similar effect. Koppula, K. S., A. Benard, and C. A. Petty, 2009, "Realizable Algebraic Reynolds Stress Closure", Chem. Eng. Sci., 64, 4611-4624. Koppula, K. S., A. Benard, and C. A. Petty, 2011, "Turbulent Energy Redistribution in Spanwise Rotating Channel Flows", Ind. Eng. Chem. Res., 50 (15), 8905-8916. Koppula, K.S., S. Muthu, A. Benard, and C. A. Petty, 2013, "The URAPS closure for the normalized Reynolds stress", Physica Scripta, T155.

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