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The Monin-Obukhov length in turbulent Taylor-Couette flow[1]

PIETER BERGHOUT, ROBERTO VERZICCO, RICHARD STEVENS, DETLEF LOHSE, Physics of Fluids Group and Max Planck Center Twente, MESA+ Institute and J. M. Burgers Centre for Fluid Dynamics, University of Twente, P.O. Box 217,, DANIEL CHUNG, Department of Mechanical Engineering, University of Melbourne, Victoria 3010, Australia — Turbulent Taylor–Couette (TC) flow is the shear driven flow in-between two concentric independently rotating cylinders. In recent years, direct numerical simulations and experiments (employing particle imaging velocimetry) revealed the shape of the mean streamwise and angular velocity profiles up to very high Reynolds numbers. However, so far no theory has been able to capture the Reynolds number effects of the mean streamwise velocity profile, and the classical von-Karman logarithmic law only fits in a minimal spatial region. In this talk, we show the application of the Monin-Obukhov length to turbulent TC flow. This length scale delineates the flow regions where the production of turbulent kinetic energy is governed either by shear or by the curvature of streamlines (centrifugal effects). We then derive an equation for the mean streamwise and angular velocity profiles that convincingly collapses the profiles for varying Reynolds numbers. Finally, we extend the analysis to varying radius ratios and find an equally convincing collapse.

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