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Turbulent strength in ultimate Taylor-Couette turbulence[1] RODRIGO EZETA, University of Twente, SANDER G. HUISMAN, Univ Lyon, Ens de Lyon, Univ Claude Bernard, CNRS, Laboratoire de Physique, F-69342 Lyon, France, CHAO SUN, Tsinghua University, DETLEF LOHSE, University of Twente
— We provide the local scaling of the Taylor-Reynolds number (Re_λ) as a function of driving strength (Ta), in the ultimate regime of Taylor-Couette flow for the inner cylinder rotation case. The calculation is done via local flow measurements using Particle Image Velocimetry (PIV) to reconstruct the velocity fields. We approximate the value of the local dissipation rate $\epsilon(r)$ using the scaling for the second order structure functions in the longitudinal and transversal directions within the inertial regime where Taylor's hypothesis is not invoked. We find an effective local scaling of $\langle\epsilon(r)\rangle_r/(\nu^3 d^{-4}) \sim Ta^{1.4}$, which is the same as the global dissipation rate obtained from both torque measurements and Direct Numerical Simulations (DNS). Additionally, we calculate the Kolmogorov length scale and find $\langle\eta(r)\rangle_r/d \sim Ta^{-0.35}$. The turbulence intensity is also calculated and it is found to scale with the driving strength as $i_\theta \sim Ta^{-0.056}$. Finally, with both the local dissipation rate and the local fluctuations available we find that the Taylor-Reynolds number scales as $\mathrm{Re}_\lambda \sim Ta^{0.18}$.

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