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The phase space of turbulent Taylor-Couette flow DETLEF LOHSE, RODOLFO OSTILLA MONICO, ERWIN VAN DER POEL, ROBERTO VERZICCO, University of Twente, SIEGFRIED GROSSMANN, University of Marburg — Direct numerical simulations of Taylor-Couette flow, i.e. the flow between two coaxial and independently rotating cylinders were performed. Shear Reynolds numbers of up to $3 \cdot 10^5$, corresponding to $Ta = 4.6 \cdot 10^{10}$, were reached. The transition to the ultimate regime, in which asymptotic scaling laws for the torque are expected to hold up to arbitrarily high driving, is analysed for different radius ratios, different aspect ratios and different rotation ratios. We also calculate the local angular velocity profiles and visualize different flow regimes that depend both on the shearing of the flow and the Coriolis force originating from the outer cylinder rotation. Two main regimes are distinguished, based on the magnitude of the Coriolis force, namely the co-rotating and weakly counter-rotating regime dominated by Rayleigh-unstable regions, and the strongly counter-rotating regime where a mixture of Rayleigh-stable and Rayleigh-unstable regions exist. The work culminates in phase spaces in the inner vs outer Reynolds number parameter space and in the Taylor vs inverse Rossby number parameter space, which can be seen as the extension of the Andereck *et al.* (J. Fluid Mech. 164, 155-183, 1986) phase space towards the ultimate regime.

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