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Three States of Counter–Rotating Turbulent Taylor–Couette Flow SEDAT TOKGOZ, GERRIT E. ELSINGA, RENE DELFOS, JERRY WESTERWEEL, Delft University of Technology, The Netherlands — In this study we experimentally investigate the change of torque at constant shear Re, and its relation to the coherent flow structures in turbulent Taylor-Couette (TC) flow. Torque measurements at counterrotating turbulent regimes show a change depending on the rotation number. In order to understand the mechanism behind this change we used tomographic PIV and measured the instantaneous 3D flow structures in turbulent TC flow. The instantaneous flow fields are decomposed into large (ILS) and smaller-scale (ISS) motions to study their contributions separately. Three distinctive flow states were found at counterrotating turbulent flow, associated with clear changes in the ILS and ISS structure. Close to only inner cylinder rotation, where well-organised Taylor-vortex-like flow structures are observed, the mean flow is responsible for the torque values. Close to exact-counter rotation, inclined ILS vortices induce velocities in the azimuthal and radial directions, contributing significantly to the torque. Close to only outer cylinder rotation the ILS vortices start to align themselves in the axial direction, resembling co-rotating Taylor column-like structures, which reduces the measured torque. The change of the orientation of the ILS vortices is also confirmed quantitatively.

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