Abstract Submitted
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Structures and scaling laws of turbulent Couette flow[1] MARTIN OBERLACK, VICTOR AVSARKISOV, Dept. Mech. Eng., TU Darmstadt, SERGIO HOYAS, Motores Termicos, Univ. Politecnica de Valencia, ANDREAS ROSTECK, Dept. Mech. Eng., TU Darmstadt, JOSE P. GARCIA-GALACHE, Motores Termicos, Univ. Politecnica de Valencia, ANDY FRANK, Dept. Mech. Eng., TU Darmstadt — We conducted a set of large scale DNS of turbulent Couette flow with the two key objectives: (i) to better understand large scale coherent structures and (ii) to validate new Lie symmetry based turbulent scaling laws for the mean velocity and higher order moments. Though frequently reported in the literature large scale structures pose a serious constraint on our ability to conduct DNS of turbulent Couette flow as the largest structures grow with increasing Re#, while at the same time Kolmogorov scale decreases. Other than for the turbulent Poiseuille flow a too small box is immediately visible in low order statistics such as the mean and limited our DNS to $Re_\tau = 550$. At the same time we observed that scaling of the mean is peculiar as it involves a certain statistical symmetry which has never been observed for any other parallel wall-bounded turbulent shear flow. Symmetries such as Galilean group lie at the heart of fluid dynamics, while for turbulence statistics due to the multi-point correlation equations (MPCE) additional statistical symmetries are admitted. Most important, symmetries are the essential to construct exact solutions to the MPCE, which with the new above-mentioned special statistical symmetry led to a new turbulent scaling law for the Couette flow.

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Martin Oberlack
Dept. Mech. Eng., TU Darmstadt

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