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Inner-outer decomposition and universal near-wall turbulent motions in turbulent channels[1] RUIFENG HU, LIMIN WANG, Lanzhou University, XIAOJING ZHENG, Xidian University — Near-wall turbulent velocities in turbulent channel flows are decomposed into small-scale and large-scale components at $y^+ < 100$, where y^+ is the viscous-normalized wall-normal height. The small-scale one is obtained by fully removing outer influences. On the other hand, the large-scale one represents the near-wall footprints of outer energy-containing motions. We present plenty of evidences that demonstrate the small-scale motions are Reynolds-number invariant with the viscous scaling, at friction Reynolds numbers between 1000 and 5200. At lower Reynolds numbers from 180 to 600, the small scales can not be scaled by the viscous units, and the vortical structures are progressively strengthened as Reynolds number increases, which is proposed as the main mechanism responsible for the anomalous scaling behavior. The finding of the universal small-scale motions in wall turbulence may be akin to the universal small scales in homogeneous and isotropic turbulence, possibly suggesting the universality of the existence of universal small-scales in different turbulent flows.

[1]NSFC(11490553 and 1197217)

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