On the near wall dissipation

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Abstract

Well resolved direct numerical simulations performed in a turbulent channel flow in large computational domains up to the Karman number of 1100 (Bauer et al., Comp. Fluids, 2015), are analyzed in order to revisit the dissipation characteristics near the wall. It is first shown that the axisymmetric homogeneous distributions (form 2) proposed by Georges & Hussein (J. Fluid Mech., 1991) provide a good approximation at all the Reynolds numbers across the whole layer. The local isotropy is never exactly reached but can be supposed to approximately hold only towards the end of the log-layer (precisely at wall distances larger than 300 wall units – wall units are the shear velocity and the viscosity). The data is further analyzed by exploring the dissipation characteristics for fixed amplitudes of fluctuating velocity components in the same way as in Tardu & Bauer (J. Turbulence, 2015) and Tardu (Phys. Fluids, 2016). Contrarily to what has been suggested before, the zero crossings of the *wall normal velocity* v in the *spanwise* direction z *contribute mostly to the dissipation* instead of longitudinal x crossings of the streamwise velocity u (Kailasnath & Sreenivasan, Phys. Fluids, 1993). In the viscous sublayer wherein the dissipation reaches its maximum and where the Reynolds number dependences are much prominent, the contribution of the spanwise zero crossings of v is about 30 %, while the contribution of u along x hardly exceeds 5 %. One of the most striking results we obtained concerns the mean dissipation conditioned by fixed amplitudes of the spanwise velocity fluctuations w. The mean dissipation condition by fixed w is remarkably constant beyond the viscous sublayer independently of the amplitude of w. This last result indicates different roads to model the dissipation in wall bounded turbulent flows.

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