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Intense dissipative mechanisms of strong thin shear layers in high Reynolds number turbulence TAKASHI ISHIHARA, Nagoya University, JST CREST, JULIAN C.R. HUNT, University College London, YUKIO KANEDA, Aichi Institute of Technology — Direct numerical simulation of box turbulence at the Taylor micro-scale Reynolds number $R_\lambda = 1131$ on 4096^3 grid points was used to show that strong thin shear layers are the significant intermittent structures of high Reynolds number turbulence. Both the distance between the layers and their widths are comparable with the integral length scale L. The layers' thicknesses ℓ are of the order of the Taylor micro-scale λ. Typically $\ell \sim 4\lambda$, where $\lambda \sim 35L/R_\lambda$. Across the significant layers there are jumps in large-scale velocities of the order of the rms velocity u_o. Within the layers, much thinner intermittent, elongated vortical eddies are generated, with microscale thickness $\ell_v \sim 178L/R_\lambda^{3/2}$ with associated large peak values of vorticity of order $u_o/\ell_v(< 35\omega_{\mathrm{rms}})$ and velocities of the order of $u_o(< 3.4u_o)$, where ω_{rms} is the rms vorticity. The vorticity of these micro-scale eddies have components predominantly parallel to the average vorticity of the thin shear layers. Their spacing is of order ℓ_v, so that vortices within the layers are reasonably close packed. The high relative magnitude of dissipation in the significant thin layers balances with the high relative magnitude of energy transfer (across the wave number k) for k larger than π/ℓ. The marked increase in the energy transfer inside the layer for k comparable with π/ℓ defines the eddy scales where the maximum energy transfer occurs from outside to inside.

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