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The structure of the vorticity field in the near-wall region of turbulent channel flow at high-Reynolds number KOJI MORISHITA, TAKASHI ISHIHARA, Nagoya University, JST CREST, YUKIO KANEDA, Nagoya University — The structure of the vorticity field in turbulent channel flow is studied by using direct numerical simulations of the incompressible Navier-Stokes equations with up to $2048 \times 1536 \times 2048$ grid points; the maximum friction Reynolds number is $Re_\tau = 2560$. Instantaneous vortex-line plots show the presence of Ω-shaped hairpin vortices in the near-wall region of turbulent channel flow. The Ω-shaped hairpin vortices in the near-wall region are well displayed by a bundle of vortex lines starting from points along a line near $y^+ = 10$ parallel to the mean stream. They suggest that the hairpin vortices are formed by instabilities and roll-ups of sheets of spanwise vorticity in the buffer layer of turbulent channel flow. The three-dimensional structure of the low-speed region of the streamwise velocity near the wall ($y^+ < 100$) is discussed in view of these vortex lines starting from the buffer layer.

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