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Large-scale motions for a high-Reynolds-number turbulent pipe flow at $Re_\tau = 3008$[1] JUNSUN AHN, KAIST, JAE HWA LEE, UNIST, JIN LEE, HYUNG JIN SUNG, KAIST — Direct numerical simulation (DNS) of turbulent pipe flow at $Re_\tau = 3008$ with a very long streamwise domain length ($L_x = 30R$, R is a pipe radius) was performed to explore the wall scaling laws in the overlap region. The high-Re turbulent pipe flow was found not to follow a log law, but rather to follow a power law. By contrast, the high-Re turbulent channel flow ($Re_\tau \geq 2006$) followed a log law. A mesolayer was observed in both the pipe and channel flows, in agreement with the power law. The retarded log law in the turbulent pipe flow was attributed to the presence of large-scale structures in the outer region of the pipe flow. These large-scale structures were more dominant in the turbulent channel flows than in the turbulent pipe flows. As the Reynolds number increased, the fluids transitioned from a power law to a log law. The development of large-scale structures in the pipe flow was slower than the corresponding development in the channel flow The proportion of large-scale and very-large-scale motions (LSMs and VLSMs) was obtained in comparison with the low-Reynolds-number pipe flow at $Re_\tau = 934$.

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