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Wall-attached structures of streamwise velocity fluctuations in turbulent boundary layer¹ JINYUL HWANG, HYUNG JIN SUNG, KAIST —

The wall-attached structures of streamwise velocity fluctuations (u) are explored using direct numerical simulation data of turbulent boundary layer at $Re_\tau = 1000$. We identify the structures of u , which are extended close to the wall. Their height (l_y) ranges from the near-wall region to the edge of turbulent boundary layer. They are geometrically self-similar in a sense that the length and width of the structures are proportional to the distance from the wall. The population density of the attached structures shows that the tall attached structures ($290 < l_y^+ < 550$) follow the logarithmic probability distribution ($\sim l_y^{-1}$), a reminiscent of the distribution for hierarchy scales of the attached eddies addressed by Perry and coworkers. The streamwise turbulent intensity of these tall attached structures follows the logarithmic distribution with the distance from the wall. The wall-attached structures of u identified in the present work are a proper candidate for Townsend's attached eddy hypothesis and these structures exist in the low Reynolds number turbulent boundary layer.

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Jinyul Hwang
KAIST

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