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The interfaces with the freestream of a spatially developing boundary layer[1] JAMES WALLACE, University of Maryland, XIAOHUA WU, Royal Military College of Canada, JEAN-PIERRE HICKEY, University of Waterloo — We have investigated the interfaces with the freestream turbulence of the laminar boundary-layer (LBFTI), turbulent spots (TSFTI) and the turbulent boundary-layer (BTFTI) using direct simulation of a zero pressure-gradient, smooth-wall boundary-layer flow developing from a laminar state, through transition, to a developed turbulent state. Probability density functions of temperature and its derivatives are used to select the interface identification thresholds. These interfaces are confirmed to be physical by the distinctive quasi-step-jump behavior in the swirling strength and temperature statistics along traverses normal to the BTFTI and TSFTI. No interface normal inflection is detected across the LBFTI for swirling strength, temperature, vorticity magnitude, Reynolds shear stress, streamwise and normal velocity or turbulent kinetic energy. This casts serious doubt on the shear-sheltering hypothesis/theory which asserts that freestream fluctuations are blocked by the LBFTI. In the early stage of transition, quasi-spanwise structures exist on the LBFTI. The TSFTI shape is dominated by head prints of concentrated hairpin vortices. Further downstream, the BTFTI geometry is strongly modulated by groves of hairpin vortices.

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