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Computational study on the internal layer in a diffuser XIAOHUA WU, JORG SCHLUTER, PARVIZ MOIN, HEINZ PITSCH, GIANLUCA IACCARINO, FRANK HAM, Center for Turbulence Research, Stanford University — We report an internal layer found in the turbulent flow through an asymmetric planar diffuser using large eddy simulation; we discuss five issues relevant to the internal layer: definition and identification, conditions for occurrence, connection with its outer flow, similarity with other equilibrium flows, and growth. The present internal layer exists in a region with stabilized positive skin friction downstream of a sharp reduction. The streamwise pressure gradient changes suddenly from slightly favorable to strongly adverse at the diffuser throat, and relaxes in a prolonged mildly adverse region corresponding to the skin friction plateau. Signatures of the internal layer include inflectional point in the wall-normal profiles of streamwise turbulence intensity, and a well-defined logarithmic slope in mean streamwise velocity underneath a linear distribution extending to the core region of the diffuser. It is interesting to note that some of these characteristics bear certain resemblance to those existing in the C-type of Couette-Poiseuille turbulent flows. Two point correlations with streamwise, wall-normal and temporal separations were used to examine connections between fluctuations inside the internal layer and those in the core region of the diffuser. The internal layer discovered from this study provides qualified support to a conjecture advanced by Azad and Kassab fifteen years ago.

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