Abstract Submitted for the DFD07 Meeting of The American Physical Society

The Effects of Wall-Permeability on the Asymptotic Suction Boundary Layer NILS TILTON, LUCA CORTELEZZI, McGill University — Experimental studies have demonstrated that transition to turbulence in boundary layers can be delayed by applying constant suction through spanwise slots, discrete holes, or porous panels on the wall. Linear stability results, however, tend to over predict the stabilizing effects of suction. One possible explanation for this discrepancy is the common assumption that the wall-tangential base-flow and the velocity perturbations vanish at the wall. This study examines the effects of wallpermeability on the linear stability of the asymptotic suction boundary layer by realistically modelling the wall as the interface between a fluid region and a fluid saturated, rigid, homogeneous, isotropic, porous material. As a result, the walltangential base-flow and the velocity perturbations no longer vanish at the wall. We restrict our study to sufficiently small permeabilities in order to neglect inertial effects in the porous region and we couple the disturbance fields in the adjacent fluid and porous regions using interface conditions derived by Ochoa-Tapia and Whitaker (1995). We perform a fully coupled, three-dimensional, linear stability analysis of the laminar flow in the fluid/porous domain. We find that the critical Reynolds number which accounts for permeability is lower than those reported in previous linear stability analyses. Hence, the overall stability of the asymptotic suction boundary layer is dictated by the competing effects of suction and wall-permeability.

> Luca Cortelezzi McGill University

Date submitted: 26 Jul 2007

Electronic form version 1.4