Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Wall distance influences on the stability and transition to turbulence of free shear layers separating at low Reynolds number[1] MATTEO DI LUCA, KENNETH BREUER, Center for Fluid Mechanics, Brown University — Using viscous linear stability calculations and experiments, we study the effects of wall proximity, represented by the shape factor H, on the laminar-to-turbulent transition of flows separating at Reynolds number 5-300 (momentum thickness based). The occurrence of transition depends on the disturbance growth rate in the separated shear layer which is mainly a function of the local shape factor and Reynolds number. For shape factors larger than 15, shear layers show large growth rates even at Re as low as 5. For smaller shape factors, however, instabilities are greatly reduced or eliminated, and the stabilizing effect of wall proximity increases as the Re number decreases. Transition was characterized experimentally at Reynolds number 20, using a thin flat plate with a thick half-ellipse leading edge. At $H_s = 22$, the experimental growth of velocity disturbances is well predicted by linear stability theory up to turbulent flow. Simulations, however, show a laminar reattachment process beginning right after separation. In a second experiment with separation closer to the wall, $H_s = 9$, laminar reattachment inhibited disturbance growth and transition to turbulence.

[1]NSF

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Date submitted: 02 Aug 2020 Electronic form version 1.4