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An investigation of natural and forced transition in a laminar separation bubble via time-resolved Particle Image Velocimetry JOHN KURELEK, SERHIY YARUSEVYCH, University of Waterloo, Waterloo, Ontario N2L 3G1, Canada — The transition process in a laminar separation bubble (LSB) formed on the suction surface of a NACA 0018 airfoil at a chord Reynolds number of 100,000 and an angle of attack of 5° is studied experimentally. Both natural and forced transition are evaluated using controlled acoustic disturbances. Time-resolved Particle Image Velocimetry and surface pressure measurements are used to investigate the streamwise and spanwise flow development in the bubble. For all the cases examined, the transition process is characterized by the formation of strongly periodic shear layer vortices in the LSB due to the amplification of disturbances in the bubble's fore portion. These structures feature strong spanwise coherence at roll-up; however, they deform rapidly and begin to break down upstream of the mean reattachment point. The vortex breakup is shown to be initiated by spanwise deformation of the vortex filaments, linked to the formation of streamwise structures. This is followed by the formation of turbulent spots, which expand rapidly near mean reattachment. The results demonstrate that the acoustic disturbance environment can have a strong influence on the characteristics of the vortices and their breakup, thereby affecting flow transition and the overall dynamics of the LSB.

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