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Mach number effects on compressible flow past a circular cylinder at high Reynolds number ZHENHUA XIA, YIPENG SHI, ZUOLI XIAO, SHIYI CHEN, State Key Laboratory for Turbulence and Complex Systems, College of Engineering, Peking University, Beijing, 100871 — Compressible flows past a circular cylinder are numerically investigated by using constrained large-eddy simulation (CLES) method at a Reynolds number of 10^6 and with Mach number varying from 0.5 to 0.95. Several mean and statistical quantities, including the drag coefficient, the separation angle, the skin friction coefficient, and the pressure fluctuations are calculated and analyzed. It is found that the separation location moves toward first and then away from the front stagnation point with the increasing Mach number. Further analysis reveals that the fluid flow in the boundary layer on the cylinder changes from turbulent to laminar when the Mach number exceeds a critical value of Mcr $\sim$ 0.65. In other words, laminar boundary-layer separation over the circular cylinder will be observed when the inlet Mach number lies in certain range under consideration. Such a phenomenon is believed to be due to the compressibility effects as Mach number increases.

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