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DNS of transcritical turbulent boundary layers at supercritical pressures under abrupt variations in thermodynamic properties[1] SOSHI KAWAI, Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency — In this talk, we first propose a numerical strategy that is robust and high-order accurate for enabling to simulate transcritical flows at supercritical pressures under abrupt variations in thermodynamic properties due to the real fluid effects. The method is based on introducing artificial density diffusion in a physically-consistent manner in order to capture the steep variation of thermodynamic properties in transcritical conditions robustly, while solving a pressure evolution equation to achieve pressure equilibrium at the transcritical interfaces. We then discuss the direct numerical simulation (DNS) of transcritical heated turbulent boundary layers on a zero-pressure-gradient flat plate at supercritical pressures. To the best of my knowledge, the present DNS is the first DNS of zero-pressure-gradient flat-plate transcritical turbulent boundary layer. The turbulent kinetic budget indicates that the compressibility effects (especially, pressure-dilatation correlation) are not negligible at the transcritical conditions even if the flow is subsonic. The unique and interesting interactions between the real fluid effects and wall turbulence, and their turbulence statistics, which have never been seen in the ideal-fluid turbulent boundary layers, are also discussed.

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