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Boundary treatment for the compressible natural convection with discrete-unified gas-kinetic scheme XIN WEN, U. of Delaware , LIAN-PING WANG, U. of Delaware and Southern U of Sci and Tech, ZHAOLI GUO, Huazhong U of Sci and Tech — The buoyancy-driven natural convection in an enclosure has been studied by researchers for several decades, it plays an important role in both flow physics study and practical applications. When the temperature difference is large, the flow is beyond the Boussinesq limit and governed by full compressible Navier-Stokes equations. An aspect that has not been well studied in the kinetic method is the boundary treatment for compressible thermal flow when the temperature field and velocity field are strongly coupled. How to implement the no-slip condition, the isothermal wall temperature and the adiabatic boundary condition can be a challenge for the kinetic method. In this talk, we propose a systematic approach of deriving the bounce-back boundary treatment for the straight boundary using the Chapman-Enskog expansion. The bounce-back expression allows the boundary nodes to satisfy the compressible Navier-Stokes equations. For a curved boundary, we implement the immersed boundary method into the discrete-unified gas-kinetic scheme (DUGKS). By design, the IB forces only contribute the leading order of momentum and energy equation, the no-slip condition and isothermal wall can then be implemented for the curved boundary.

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