

Continuous non-equilibrium transition driven by the heat flow

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We discovered an out-of-equilibrium transition in the ideal gas between two walls, divided by an inner, adiabatic, movable wall. The system is driven out-of-equilibrium by supplying energy directly into the volume of the gas. At critical heat flux, we have found a continuous transition to the state with a low-density, hot gas on one side of the movable wall and a dense, cold gas on the other side. Molecular dynamic simulations of the soft-sphere fluid confirm the existence of the transition in the interacting system. We formulate description of nonequilibrium stationary state of the system in terms of global thermodynamic functions and introduce a stationary state Helmholtz-like function whose minimum determines the stable positions of the internal wall. This transition can be used as a paradigm of transitions in stationary states and the Helmholtz-like function as a paradigm of the thermodynamic description of these states.