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Heat-transport measurements for ethane in a turbulent liquid-vapor two-phase state.[1] JIN-QIANG ZHONG, GUENTER AHLERS, UCSB —

Below the critical point (CP) at P_c, T_c liquid and vapor co-exist along a line $T_\phi(P)$ in the temperature-pressure plane. When a fluid at $P < P_c$ is heated from below and $\Delta T = T_b - T_t$ (T_b and T_t are the temperatures at the bottom and top of the sample respectively) straddles T_ϕ, then liquid can condense at the top and drop to the bottom. This process will contribute strongly to the effective conductivity λ_{eff} of the sample. We measured λ_{eff} using ethane close to but **below** the CP along various isobars using a constant ΔT and varying $T_m = (T_t + T_b)/2$. For $T_t > T_\phi$ the sample was in the single-phase vapor region and λ_{eff} exceeded the pure conduction value because the sample underwent turbulent convection. As T_m was decreased so that T_t entered the two-phase region, we found that the heat transport was enhanced further, but that the enhancement did not start until T_t reached a critical value $T_t^c < T_\phi$. At that point a meta-stable boundary layer at the sample top was assumed to have reached a sufficient thickness for nucleation of liquid to occur. For $T_t < T_t^c$ the heat transport increased continuously and linearly with decreasing T_t. When T_t decreased sufficiently, λ_{eff} reached a maximum where it was an order of magnitude larger than in the single-phase state.

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