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Two-layer Thermally Driven Turbulence: Mechanisms for Interface Breakup HAORAN LIU, KAI LEONG CHONG, QI WANG, CHONG SHEN NG, Univ of Twente, ROBERTO VERZICCO, Univ of Rome, DETLEF LOHSE, Univ of Twente — It is commonly accepted that the breakup criteria of drops or bubbles in turbulence is governed by surface tension and inertia. However, also buoyancy can play an important role at breakup. In order to better understand this role, here we numerically study (two-dimensional) Rayleigh-Bénard convection for two immiscible fluid layers. We explore the parameter space spanned by the Weber number $5 \leq We \leq 5000$ and the density ratio between the two fluids $0.001 \leq \Lambda \leq 1$, at fixed Rayleigh number $Ra = 10^8$ and Prandtl number $Pr = 1$. At low We, the interface undulates due to plumes. When We is larger than a critical value, the interface eventually breaks up. Depending on Λ, two breakup types are observed: The first type occurs at small $\Lambda \ll 1$ (e.g. air-water systems) when local filament thicknesses exceed the Hinze length scale. The second, strikingly different, type occurs at large Λ with roughly $0.5 < \Lambda < 1$ (e.g. oil-water systems): The layers undergo a periodic overturning caused by buoyancy overwhelming surface tension. For both types the breakup criteria can be derived from force balance arguments and show good agreement with the numerical results.

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