Unifying constitutive law of vibroconvective turbulence in microgravity

Quan Zhou*[1]

[1]Shanghai University – China

Abstract

We report the unified constitutive law of vibroconvective turbulence in microgravity, i.e. $Nu \sim a\hat{}{-}1Re\_os\hat{}\beta$ where the Nusselt number Nu measures the global heat transport, a is the dimensionless vibration amplitude, Re_os is the oscillational Reynolds number and β is the universal exponent. We find that the dynamics of boundary layers plays an essential role in vibroconvective heat transport and the Nu-scaling exponent β is determined by the competition between the thermal boundary layer (TBL) and vibration-induced oscillating boundary layer (OBL). Then a physical model is proposed to explain the change of scaling exponent from $\beta = 2$ in the TBL-dominant regime to $\beta = 4/3$ in the OBL-dominant regime. Our finding elucidates the emergence of universal constitutive laws in vibroconvective turbulence, and opens up a new avenue for generating a controllable effective heat transport under microgravity or even microfluidic environment in which the gravity effect is nearly absent.

*Speaker