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Differential diffusion of high Prandtl number scalars in stratified turbulence HIDESHI HANAZAKI, TAKEHIRO MIYAO, Kyoto University — Differential diffusion in stratified turbulence is investigated by direct numerical simulations (DNS) when the stratifying/active scalar has a Prandtl number Pr=6 (or 1), and the coexisting passive scalar has a Prandtl number of Pr=1 (or 6). When the stratifing scalar has Prandtl number larger than unity ($Pr = 6 > 1$), energy spectrum of high-Pr stratifying scalar fluctuations approaches to that of kinetic energy in five buoyancy oscillations ($Nt/2\pi < 5$), where N is the Brunt-Vaisala frequency. This occurs through persistently negative buoyancy flux at small scales, which transfer potential energy to wave part of kinetic energy. The process continues until the balance between potential energy and wave kinetic energy is satisfied. Time development of the ratio of Ozmidov scale to Kolmogorov scale, or the Froude number defined at the Kolmogorov scale, becomes smaller than unity in one buoyancy period ($Nt/2\pi < 1$), supporting the appearance of this dominantly linear process at small scales. Then, the time scale of this phenomenon seems to be determined largely by the buoyancy time scale, and not by the turbulent time scale. In contrast, when the stratifying scalar has Prantdl number equal to unity ($Pr = 1$) the coexisting high-Pr ($Pr = 6$) passive scalar maintains high level of fluctuations at small scales, in agreement with Batchelor scalings.

Hideshi Hanazaki
Kyoto University

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