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Large-scale anisotropic structure of a passive scalar in turbulence under a uniform mean gradient at low Schmidt numbers[1] TATSUYA YASUDA, TOSHIYUKI GOTOH, TAKESHI WATANABE, IZUMI SAITO, Nagoya Institute of Technology — We have run direct numerical simulations (DNS) of passive scalar turbulence in a triply periodic box with various parameter sets. The homogeneous isotropic turbulent velocity field is achieved by a Gaussian white-noise forcing, and passive scalar fluctuations are sustained with a uniform mean scalar gradient. In so doing, we discover that the degree of anisotropy in passive scalar fluctuation is well predicted by not the Schmidt number $\mathrm{Sc} = \nu/\kappa$ but the Peclet number $\mathrm{Pe}_\lambda = u'\lambda_\theta/\kappa$, where ν, κ, u' and λ_θ are the kinematic viscosity, molecular diffusivity, root-mean-square velocity and Taylor-micro scale for turbulent scalar field, respectively. We also find that, at sufficiently low Peclet numbers, very large-scale scalar structures, which elongate along the direction of the uniform mean scalar gradient, are generated and sustained by the action of scalar diffusion and the mean scalar gradient. They can emerge irrespective of Reynolds numbers as long as the Peclet number is sufficiently low.

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Tatsuya Yasuda
Nagoya Institute of Technology

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