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Energy spectrum of stably-stratified and convective turbulent flows MAHENDRA VERMA, ABHISHEK KUMAR, IIT Kanpur, India — In the inertial range of fluid turbulence, the energy flux is constant, while the energy spectrum scales as $k^{-5/3}$ (k=wavenumber). The buoyancy however could change the phenomenology dramatically. Bolgiano and Obukhov (1959) had conjectured that stably stratified flows (as in atmosphere) exhibits a decrease in the energy flux as $k^{-4/5}$ due to the conversion of kinetic energy to the potential energy, consequently, the energy spectrum scales as $k^{-11/5}$. We show using detailed numerical analysis that the stably stratified flows indeed exhibit $k^{-11/5}$ energy spectrum for Froude numbers Fr near unity. The flow becomes anisotropic for small Froude numbers. For weaker buoyancy (large Fr), the kinetic energy follows Kolmogorov's spectrum with a constant energy flux. However, in convective turbulence, the energy flux is a nondecreasing function of wavenumber since the buoyancy feeds positively into the kinetic energy. Hence, the kinetic energy spectrum is Kolmogorov-like ($k^{-5/3}$) or shallower.[1] We also demonstrate the above scaling using a shell model of buoyancy-driven turbulence.[2]

[1]A. Kumar, A. G. Chatterjee, and M. K. Verma, PRE, **90**, 023016 (2014)
[2]A. Kumar and M. K. Verma, PRE, **91**, 053005 (2015)

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