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Analysis of Intermittency of Turbulence by Lagrangian Renormalized Perturbation Method YUKIO KANEDA, KAZUTO UENO, Nagoya University — We applied a Lagrangian renormalized perturbation (RPT) method to analyze the intermittency of the enstrophy and the energy dissipation rate in incompressible turbulence. A simple dimensional argument using the mean energy dissipation rate and wave number k shows that both of the spectra of the squares of these fields scale as $\propto k^{5/3}$ in the inertial subrange. On the other hand, recent direct numerical simulations with the Taylor micro-scale Reynolds number up to about 1200 suggest that they scale as $\propto k^a$ in the range, with the exponent a about $-2/3$ instead 5/3, while the spectrum of the square of the Laplacian of the pressure scales as $\propto k^a$ with $a \sim 1.8$, in fairly good agreement with the normal scaling $a = 5/3$. All of the enstrophy, the energy dissipation rate and the Laplacian of the pressure are second order in the first space derivative of the velocity. The difference between the spectra comes only from the difference in their componental or tensorial dependence on the velocity derivatives. It is therefore unlikely that any theory discarding the tensorial dependence would explain the difference. The lowest order terms in the RPT expansions agree with the quasi-normal approximation and give the normal scaling $\propto k^{5/3}$ for these spectra. However, a class of higher order terms is shown to give intermittency corrections to the spectra of the squares of the enstrophy and the energy dissipation rate, which involve the dissipation length scale.

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