

**Turbulent Flows**  
Stephen B. Pope  
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**Solution to Exercise 13.17**

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With the given assumptions the energy spectrum can be estimated by the Kolmogorov spectrum

$$E(\kappa) \approx C\varepsilon^{2/3}\kappa^{-5/3}. \quad (6.239)$$

The mean residual kinetic energy equals to

$$\begin{aligned} \langle k_r \rangle &= \int_{\kappa_c}^{\infty} E(\kappa) \, d\kappa \\ &\stackrel{(6.239)}{\approx} \int_{\kappa_c}^{\infty} C\varepsilon^{2/3}\kappa^{-5/3} \, d\kappa \\ &= -\frac{3C\varepsilon^{2/3}}{2\kappa^{2/3}} \Big|_{\kappa_c}^{\infty} \\ &= \frac{3}{2}C \left( \frac{\varepsilon}{\kappa_c} \right)^{2/3} \\ &\stackrel{(13.14)}{=} \frac{3}{2}C \left( \frac{\Delta\varepsilon}{\pi} \right)^{2/3}. \end{aligned} \quad (1)$$

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