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On the effects of Taylor-lengthscale size particles on isotropic turbulence F. LUCCI, University of California, Irvine, A. FERRANTE, University of Washington, S. ELGHOBASHI, University of California, Irvine — The effects of spherical particles of Taylor-lengthscale size ($d \sim \lambda$) on isotropic turbulence are studied via DNS. A mesh of 256^3 grid points is used with an initial microscale Reynolds number $Re_{\lambda 0} = 75$. The flow around 6400 freely-moving particles is fully resolved using the Immersed Boundary method. The maximum volume fraction of the particles is $\phi_v = 0.1$. The maximum density ratio is $\rho_p/\rho_f = 10$ which corresponds to a mass fraction $\phi_m = 1$. Our results show that particles with diameter $d \sim \lambda$ always reduce the turbulence kinetic energy (TKE), mostly by enhancing its dissipation rate, $\varepsilon(t)$. The augmented dissipation rate exceeds $\Psi_p(t)$, the rate of increase of TKE due to the two-way coupling force imparted by the particles on the surrounding fluid. The increased dissipation rate occurs close to the front of the particle surface due to the increased strain rates (both extensional and compressive) as the particles move through the surrounding turbulent eddies. For fixed volume fraction and diameter of the particles, the most pronounced effects on TKE, its dissipation rate and its rate of change due to two-way coupling occur by increasing the ratio ρ_p/ρ_f which is directly proportional to the Stokes number, (τ_p/τ_k), and the particles mass fraction, ϕ_m.

S. Elghobashi
University of California, Irvine

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