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On the two-way interactions between dispersed particles and turbulent flows

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Particle-laden turbulent flows are ubiquitous in nature (e.g. dust storms on Earth and Mars) and in industrial applications (e.g. liquid fuel and pulverized coal sprays in combustion chambers). Experimental and numerical studies of these flows are quite challenging due to the wide spectra of length- and time-scales of the dispersed particles in addition to the spectra of scales intrinsic to the carrier fluid turbulence. The two-way nonlinear interactions between the dispersed particles and the turbulence result in complex multi-scale physical phenomena. The lecture focuses on the physical mechanisms of the two-way interactions between dispersed spherical particles and simple turbulent flows using Direct Numerical Simulation (DNS). Particles whose diameter is smaller than the Kolmogorov length scale of turbulence are simulated as point particles. Results of particle-laden isotropic and homogeneous shear turbulent flows are presented. Particles with diameter larger than the Kolmogorov length scale are fully resolved using the Immersed Boundary method. Results of fully resolved particle-laden isotropic turbulence are presented.