Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

Interaction of a spherical particle with freestream turbulent flow: Effect of microscale Reynolds number PROSENJIT BAGCHI, Rutgers University — The interaction of an isolated rigid sphere with an isotropic turbulent ambient flow is considered using a direct numerical simulation. The turbulence field is obtained from one realization of a separate DNS calculation (Donzis et al, JFM (2005), vol. 532; Yeung et al, JFM (2007) vol. 582), and used as the inflow condition for the flow around the sphere. This study is an extension of an earlier work (Bagchi and Balachandar, Phys. Fluids (2003), vol. 15; Bagchi and Balachandar, JFM (2004), vol. 518), where the Taylor microscale Reynolds number, R_λ, of the turbulence field was kept constant at 164. In the present study, we consider the effect of varying R_λ as 38, 90, 140 and 240. The sphere Reynolds number (based on the diameter and relative velocity) is in the range 63 to 400, and the sphere diameter varies from 1 to 8 times the Kolmogorov scale, and 0.18 to 0.0042 times the integral length scale, of the ambient turbulent flow. We present DNS results on the drag and lift forces, and added-mass and history forces on the sphere under varying R_λ, and compare them with the analytical results. Mean, RMS and PDF of these forces are analyzed. We also present transition in the sphere wake as R_λ is varied. Mean wake, and the modulation of the freestream turbulence in the wake are also presented under varying R_λ of the ambient flow.

Prosenjit Bagchi
Rutgers University

Date submitted: 04 Aug 2008 Electronic form version 1.4