Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

History and added mass forces on a spherical particle at finite Reynolds numbers[1] LULAMA WAKABA, S. BALACHANDAR, University of Illinois, Urbana-champaign — The unsteady force on a spherical particle, immersed in an ambient flow, can be expressed as a sum of quasi-steady, added mass, pressure gradient and history forces. Interestingly, at finite Re the history contribution is quite complex even in an unsteady uniform flow, exhibiting a non-monotonic behavior. Furthermore, its behavior for acceleration and deceleration is not symmetric. In the presence of ambient shear, unsteady conditions give rise to history contributions for both drag and lift. The behavior of lift is particularly interesting, since the history-induced complexities are magnified. In this study, the history kernels for drag and lift are extracted and investigated for a range of Reynolds numbers. Unlike drag, the lift kernel is found to scale linearly with Reynolds number and shear rate. An investigation of the added mass for an accelerating/decelerating particle with an existing wake is also presented. Particular emphasis is placed on the interaction between an imposed rapid acceleration/deceleration and a pre-existing finite Reynolds number wake. The results clearly establish the independence of added mass coefficient on acceleration number and the prior state of flow.

[1]Supported by CSAR under DoE subcontract B341494

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Date submitted: 12 Aug 2005 Electronic form version 1.4