Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Equation of Motion for a Drop or Bubble in Viscous Compressible Flows M. PARMAR, S. BALACHANDAR, A. HASELBACHER, University of Florida — Here we theoretically analyze the unsteady motion of a bubble/drop with the inclusion of compressibility effects,but in the limit of vanishing Mach and Reynolds numbers. Linearized viscous compressible Navier-Stokes equations are solved inside and outside of the spherical bubble/drop and an expression of the transient force is first obtained in the Laplace domain and then transformed to the time domain. The total force is separated into the quasi-steady, the inviscid-unsteady, and the viscous-unsteady contributions. The quasi-steady and inviscid unsteady forces are the same as those given in the literature for an incompressible drop in an incompressible flow and for a particle in a compressible flow, respectively. For large times, the viscous unsteady force on a drop is the same as that in an incompressible flow. For acoustically short times, the viscous unsteady force is modified due to compressibility effects. Contrary to the finding in incompressible flow, where the viscous unsteady force on a bubble becomes non-singular for short times, the compressibility re-introduces an inverse-square-root decay rate. The present theoretical results are valid only in the limit of zero Mach- and Reynolds-numbers, using DNS we extend the results to finite Reynolds- and Mach-numbers.

S. Balachandar
University of Florida

Date submitted: 03 Aug 2012 Electronic form version 1.4