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Levitation of Falling Spheres in Stratified Fluids[1] RICHARD MCLAUGHLIN, ROBERTO CAMASSA, BYRON HUFF, RICHARD PARKER, University of North Carolina, UNC RTG FLUIDS GROUP COLLABORATION —
The motion of sphere's falling under the influence of gravity is a classical problem dating back to Galileo and earlier. How a falling body additionally interacts with its environment is an equally challenging problem and involves strong coupling between the body and fluid via hydrodynamic drag. We present new phenomena[2] concerning the motion of a sphere falling through a sharply stratified (two layer) fluid in which the falling heavy body stops and reverses its direction (bounces) before ultimately returning to descent. Shadowgraph imaging shows the physics responsible for this surprising motion is a coupling between the body and the ambient boundary layer fluid, which is endowed with a negative potential energy as it is drawn into the lower layer, forming a rising turbulent plume. The hydrodynamic coupling between the sphere and this plume temporarily arrests the motion, even causing the bead to rise back through the transition layer. We present measurements of this trapping phenomena, and report the long residence times in which the sphere is trapped within the transition layer as a function of the bottom layer fluid density field for an array of different sized spheres. [2] N. Abaid, D. Adalsteinsson, Akua Agyapong, and R. M. McLaughlin, "An Internal Splash: Falling Spheres in Stratified Fluids," Physics of Fluids, 16, no. 5, 1567-1580, 2004.

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