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Bare Shear Viscosity and Anomalous Fall Rate of Oil Droplets in Nitrogen RODNEY VARLEY, Hunter College C.U.N.Y. — Experimental evidence of Kim and Fedele (1982) indicates a breakdown of the Millikan Law for the fall rate of oil droplets in Nitrogen gas over a pressure range of 1-15 atm. The discrepancy is most pronounced for smallest, 0.1 micron radius droplets for which the fall rate increases with pressure. The opposite behavior was observed by Millikan with larger drops in air of pressure at most one atm. We explain these results by arguing that the particle's motion, in particular Stokes' drag formula, is determined by the so-called bare shear viscosity which applies to micro fluid flows. This is in contrast with the usual theory which uses a renormalized shear viscosity and which is well approximated by the Enskog value. A mode coupling formula for the bare shear viscosity is discussed and a graphical comparison is made with the experimental results. Basically an increase in gas pressure produces a decrease in the bare shear viscosity and thus the fall rate increases. The idea that the shear viscosity is smaller for micro flows is consistent with the intuitive belief that on small enough spatial and time scales, fluid flows are conservative without dissipation.

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