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The Interactions Between Two Rotating Dipoles Inside Electrorheological Fluids Y. C. LAN, R. TAO, Dept. of Physics, Temple University, Philadelphia, PA — Interactions between rotating dipoles are important in study of electrorheological (ER) fluids since the induced electric dipoles in ER fluids may rotate under the shearing flow. There have been some theoretical predictions that regardless of the hydrodynamic complexion, the rotation, even very slow rotation, will significantly reduce the dipolar interaction and make the interaction vanishing as the rotation speed increases. The actual ER experiments are very difficult to interpret or compared with these theoretical predictions since the rotation definitely induces a hydrodynamic force, which is usually significant. To clarify the issue, we conducted an experiment with two electric-field induced dipoles in dry argon gas. One of the dipoles rotated in the direction perpendicular to the electric field and the other was connected to a microbalance to measure the dipolar interactiion. The following three different situations were investigated: (a) both dipoles were metal spheres; (b) one dipole was a metal sphere and the other was a dielectric sphere; (c) both dipoles were dielectric spheres. The experiment finds that the attractive force between the two dipoles indeed decreases with the rotation. However, in case with two metal spheres, the dipolar force tends to a non-zero constant as the rotation speed increases. In the metal-dielectric case and dielectric- dielectric case, the dipolar force monotonically decreases with the increasing rotation speed.

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