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A Sinusoidal Applied Electric Potential can Induce a Long-Range, Steady Electrophoretic Force SEYYED HASHEMI AMREI, WILLIAM D. RISTENPART, GREG R. MILLER, University of California Davis — We use the standard electrokinetic model to numerically investigate the electric field in aqueous solutions between parallel electrodes under AC polarization. In contrast to prior work, we invoke no simplifying assumptions regarding the applied voltage, frequency, or mismatch in ionic mobilities. We find that the nonlinear electromigration terms significantly contribute to the overall shape of the electric potential vs. time, which at sufficiently high applied potentials develops multi-modal peaks. More surprisingly, we find that electrolytes with non-equal mobilities yield an electric field with non-zero time average at large distances from the electrodes. Our calculations indicate this long-range electric field suffices to levitate colloidal particles many microns away from the electrode against the gravitational field, in accord with experimental observations of such behavior (Woehl et al., PRX, 2015). Moreover, the results indicate that particles will aggregate laterally near electrodes in some electrolytes but separate in others, helping explain a longstanding but not well understood phenomenon.

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