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Ion correlation and ion steric effects on electrophoresis of a colloidal particle ROBERT STOUT, ADITYA KHAIR, Dept. of Chemical Engineering, Carnegie Mellon University — We revisit the classic problem of electrophoresis of a spherical colloid, using modified PNP equations that account for: (i) steric repulsion between finite sized ions through Bikerman's model [1]; and (ii) electrostatic correlations between ions via a modified Poisson equation recently proposed by Bazant et al. [2]. At low particle zeta potentials, we derive an analytical formula for the electrophoretic mobility accounting for ion correlations, which predicts mobility reversals at sufficiently large ion correlation lengths. Next, we develop an asymptotic scheme for thin Debye layers to compute the mobility for larger zeta potentials, where ion steric effects impose a limit on the counter-ion density in the diffuse Debye layer. Our calculations are compared to experiments on electrophoresis in concentrated multivalent electrolytes.

[1] J. J. Bikerman, Philos. Mag. 33, 384 (1942)
[2] M. Z. Bazant, B. D. Storey, and A. A. Kornyshev, Phys. Rev. Lett. 106, 046102 (2011).

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