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Charged Polymers in Electric Fields

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Charged polymers in solution are considered under the action of external electric fields. An electric field acts simultaneously on charged groups of the polyelectrolyte and on mobile counterions. As a result, charges are displaced and a dipole moment is produced, which leads to stretching and orientation of the polymer parallel to the external field. On the the other hand, hydrodynamic effects favor a perpendicular orientation of stiff polymers with respect to the external field, which is related to the phenomenon of anomalous birefringence. By performing hydrodynamic simulations, the relation between the electrophoretic mobility and the non-equilibrium perturbation of the polymer structure is investigated which results from a competition between electro-friction effects when counterions glide along the polymer backbone and coupling between hydrodynamic and elastic forces. Friction effects are more pronounced when polymers are confined, for example when they move through pores or when they adsorbed at surfaces.