**Polymer Physics**

**Homework 4**

**February 4, 2022 (Due February 8)**

The persistence length, *l*p, for polyelectrolytes is usually described as a function of charge spacing, *a*, the bare persistence length, *l*0, the Bjerrim length, *l*b, and the Debye screening length *l*d.

1. Singh and Radhakrishnan *Collapse of a Confined Polyelectrolyte Chain under and AC Electric Field* Macromolecules **54** 7998-9007 (2021) use a coarse-grain molecular dynamics simulation to demonstrate the mechanism for chain folding in DNA when subject to an alternating electric field, especially in confined microfluidic channels. This is of interest since gel electrophoresis is used to separate DNA sequences and the use of electrophoresis in microchannel MEMS devices for nucleic acids and proteins is seen as a tool for rapid at-site medical testing, for instance screening for genetic defects during a doctor visit by a simple finger prick using a handheld device (Pan, Fang, Fang, Hu, Fang *A Low-Cost Palmtop High-Speed Capillary Electrophoresis Bioanalyzer with Laser Induced Fluorescence* Detection Nature **8** 1791 (2018)). Singh considers five factors impacting the folding process, a capillary diameter, *R*p, hydrodynamic interactions (HI) between chains, the frequency of the AC field, **, the magnitude of the field, *E*, and the persistence length of the chain, *l*p,

The HI are calculated using multi-particle collision dynamics, MPC. From the webpage <https://en.wikipedia.org/wiki/Multi-particle_collision_dynamics> describe MPC. Obtain the expression for the mean free path, **, from *E* = ½ *mv*2.

1. There are

.)

1. Equation 1 is 1 for perfect alignment.
2. . Comment on the time dependence that is available from Chen’s simulation in Figure 3.
3. ?