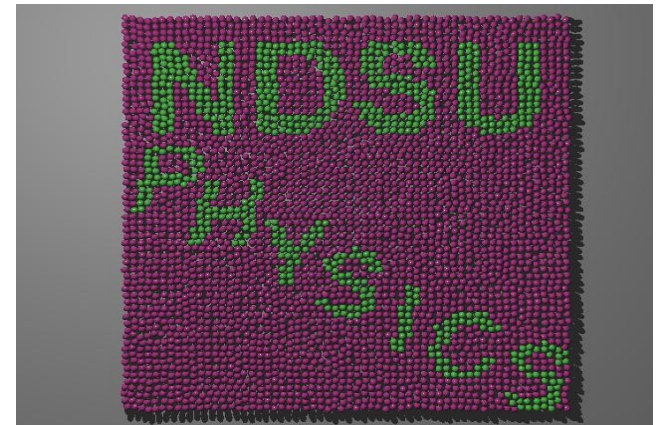
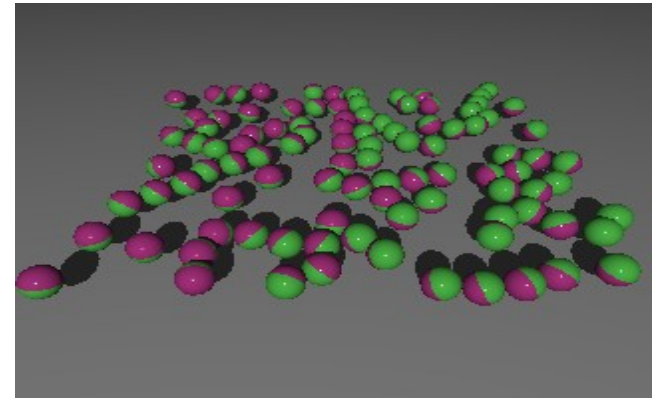


# Theoretical and Computational Studies of Macromolecular Materials

Alan R. Denton, North Dakota State University, DMR-0204020

Colloids are tiny particles, nanometers to microns in size, dispersed in a liquid. Colloidal suspensions exhibit complex structures that depend sensitively on interparticle interactions and on the influence of externally applied fields.

My group is using Monte Carlo computer simulation methods to model the behavior of two-dimensional layers of spherical colloids, interacting by various interparticle forces, in external fields. For example, electric dipole interactions occur if opposite sides of each particle are oppositely charged. Orientations of the electric dipoles then can be controlled by an external electric field. If opposite hemispheres of the particles also have different colors, and colloids are confined to a thin conducting polymer film, applications to high-resolution displays are possible.



Absent an applied electric field, electric dipole interactions favor string-like and ring-like structures. A spatially-varying electric field creates an image in a 2D colloidal crystal.

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## Education and Outreach

Two undergraduate students (John Maxwell, Dayin Li), one Ph.D. student (Ben Lu), and one postdoctoral fellow (Hao Wang) are all contributing to the work on dipolar colloids in external fields. In addition to this project, we also are applying theoretical and computational methods to model effective interparticle interactions and phase behavior in other soft, macromolecular materials, including charge-stabilized colloidal suspensions, polyelectrolyte solutions, and colloid-polymer mixtures.

Members of the group are receiving training in applying simulation and other numerical methods to modeling soft materials and all have presented results of their research at scientific conferences. The PI has given presentations on soft materials to student groups and also is involved in implementing online learning network software for use in introductory Physics classes at NDSU and for outreach to local and regional high schools.