Interactions between particles in nematic colloids studied by magneto-optical tweezers

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We measured and numerically modelled the interactions between spherical particles immersed in a nematic liquid crystal. The particles induced planar anchoring and the elastic distortions in the director field resulted in very strong and highly anisotropic long-range forces between them. By using magneto-optical tweezers, we studied these forces as a function of interparticle separation in confined samples. The interparticle potential follows the theoretically predicted power-law dependence for small particle separations whereas for larger separations we demonstrate that the potential decreases exponentially with the characteristic decay length proportional to the sample thickness. The observed cross-over in the potential occurs at a particle separation that is comparable to the thickness of the sample. This is in excellent agreement with classical electrostatics analogy, where spheres act as quadrupoles and sample surfaces inducing homeotropic anchoring as conducting plates. Additionally, temperature dependence of the interparticle potential is studied. The results are reproduced by numerical modelling based on the Landau-de Gennes free-energy minimisation approach.

References

(1) J. Kotar, M. Vilfan, N. Osterman, D. Babič, M. Čopič, and I. Poberaj, *Phys. Rev. Lett.* **2006,** *96,* 207801.
(2) M. Vilfan, N. Osterman, M. Čopič, M. Ravnik, S. Žumer, J. Kotar, D. Babič, and I. Poberaj, *Phys. Rev. Lett.* **2008**, *101,* 237801.