# Effect of confinement on the interaction between colloidal particles in a nematic liquid crystal: A theoretical study

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We investigate theoretically how confinement by two parallel surfaces affects the interaction between spherical colloidal particles mediated by the elastic distortion of a host nematic liquid crystal. Our study is motivated by a recent experimental study[(1)] which found an exponential decay in the long-distance interaction potential between colloidal particles in a nematic liquid crystal.

Our calculation is carried out analytically under the assumption of weak anchoring on the particle surfaces[(2,3)]. We show that the short-range potential follows a power law $U(r) \sim r^{-5}$, with $r$ being the inter-particle distance, which is expected from the quadrupolar nature of the interaction when the confining surfaces do not affect the interaction significantly. On the other hand, long-range potential can be well described by an exponential function $U(r) \sim (d/r)^{1/2} \exp(-2\pi r/d)$, where $d$ is the cell thickness. These two regimes are interchanged at $r/d \cong 0.8$. This behavior of $U(r)$ is in a good semi-quantitative agreement with experiments[(1)].

References
(1) M. Vilfan et al. *Phys, Rev. Lett.* **2008**, *101*, 237801.
(2) J. Fukuda et al. *J. Phys.: Condensed Matter* **2003**, *15*, 3841.
(3) J. Fukuda and S. Žumer, in preparation.