Massive field theory approach for polymer chains in confined geometries

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Using the massive field theory approach directly at fixed dimensions $d = 3$ we calculated the depletion interaction potential and depletion force between two repulsive, two inert and one repulsive and one inert walls confining a dilute solution of long flexible polymer chains. The obtained calculations for all cases of polymer-surface interactions were performed for the ideal chain and real polymer chain with excluded volume interactions in the wide slit regime. Besides, we used some assumptions which allowed us to estimate the depletion interaction potential in the region of narrow slit. The obtained results are in very good agreement with previous theoretical investigations [1] and with results of Monte Carlo simulations [2] for the case of two repulsive walls. Taking into account Derjaguin approximation we obtained good qualitative agreement with experimental data [3] for the depletion potential between a spherical colloidal particle of big radius and repulsive wall. The obtained results confirm that the depletion interaction potential and the resulting depletion force between two walls are weaker for chains with excluded volume interaction (EVI) than for ideal chains, because the EVI effectively reduces the depletion effect near the walls.

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