gravitational effects on the solute particles are negligible. Although this model is highly simplified, the sedimentation of exopolysaccharide-producing bacteria onto surfaces is important in the formation of biofilms [37]. Here, the hard surface case might mimic the initial stages of biofilm formation, when bacteria sediment onto an uncolonised surface, while the absorbing surface might correspond to a situation where bacteria sediment onto an already formed biofilm which tends to absorb exopolysaccharide.

We determine the steady-state probability distribution function for the chucker position relative to the surface in our MC simulations. This would correspond to an experimental sedimentation density profile, in the case of low chucker density where interactions between chuckers can be ignored. In all our simulations, we take $R_1/R_2 = 10$, $F = 7.0 k_B T/R_1$ and initialise the simulations with the centre of the colloid at a distance $z = 1.6R_1$ from the surface; we then begin to observe the system once a steady state has been reached (i.e. after 9×10^5 Monte Carlo cycles). This choice of F approximately corresponds to the gravitational force experienced by a typical bacterium.

Figure 13 shows the steady-state probability distribution $P(z)$ for the position of the centre of the chucker relative to the surface, which is at $z = 0$. In Figure 13(a), the wall acts as a sink for solute particles. This results in a buildup of the chucker probability density close to the surface: the higher the chucking rate, the more tightly the chucker tends to approach the surface. This effect can be understood in terms of an effective attractive interaction between the chucker and the surface, in which local depletion of solute near the surface causes an osmotic imbalance which squeezes the chucker against the surface. Figure 13(b) shows the corresponding probability density profiles when the planar surface instead acts as a hard wall. Here we find two regimes, depending on the chucking rate. For small chucking rates ($k_c R_2^2/D_1 \leq 1$), the probability density decreases monotonically away from the surface, with a steepness that decreases as k_c increases (for $k_c = 0$ we obtain a Boltzmann distribution). However, as k_c increases further, the profile develops a minimum close to the surface and a peak at some distance from the surface. This peak recedes from the surface with increasing k_c. For the hard surface, there is a solute-mediated osmotic repulsion between the chucker and the surface. The crossover between the two types of probability density profile occurs when this repulsion becomes strong enough to overcome the gravitational force pulling the chucker towards the surface. In the high k_c regime, the peak in $P(z)$ occurs where the gravitational and osmotic repulsion forces balance. We note