Fluid dynamics in charge stabilized colloidal suspensions
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The structure factor is essentially the Fourier transform of the radial distribution function \( g(r) \), which gives the relative conditional probability of finding a particle at a distance \( r \) apart from another particle [9]. The pair distribution function is related to the direct correlation function \( c(r) \) by the Ornstein-Zernike equation [69]:

\[
h(r) = c(r) + n h(r) \ast c(r),
\]

where \( h(r) = g(r) - 1 \) is the total correlation function, \( n \) the particle number density, and the symbol \( \ast \) denotes a convolution product. To calculate \( g(r) \) [and therefore \( S(q) \)] for a given potential, eq. A.1 has to be closed by an additional relation. We will employ the so-called HMSA closure here, proposed by Zerah and Hansen [112]. This closure relation reads

\[
g(r) = \exp\left\{-u_1(r)/k_B T\right\} \left(1 + \frac{\exp\{f(r)[h(r) - c(r) - u_2(r)/k_B T]\} - 1}{f(r)}\right),
\]

where \( u_1(r) \) is the repulsive part of the interparticle potential and \( u_2(r) \) the attractive part. The "switching function" \( f(r) \) is parameterized by

\[
f(r) = 1 - \exp\{-\zeta r\}.
\]

For a given potential, the parameter \( \zeta \) is varied until thermodynamic consistency is achieved, that is, until the isothermal compressibility obtained from the Ornstein-Zernike equation is equal to the one obtained from the virial
equation\textsuperscript{1}. The closure A.2 interpolates between the hypernetted-chain closure \([f(r) = 1]\) and the soft mean spherical approximation \([f(r) = 0]\), which are both thermodynamically inconsistent \([112]\). For a purely repulsive potential \([u_2(r) = 0]\), the soft mean spherical approximation reduces to the well-known Percus-Yevick closure and, consequently, the HMSA scheme to the thermodynamically consistent Rogers-Young (RY) closure \([9]\). Since the DLVO potential is purely repulsive, the closure A.2 is identical to the RY-closure. The accuracy of the RY closure in conjunction with the DLVO potential has been demonstrated by D'Aguanno and Klein by comparison with computer simulation results \([113]\). The particular numerical scheme we use has successfully been applied to Lennard-Jones systems \([112, 114]\). We tested the scheme for the case of a DLVO potential by comparison with published computer simulation data \([113, 115]\) and found agreement to better than 5\%.

\[ \chi_T^{-1} = n(\partial P/\partial n)_T, \text{ where } P \text{ is the pressure.} \]