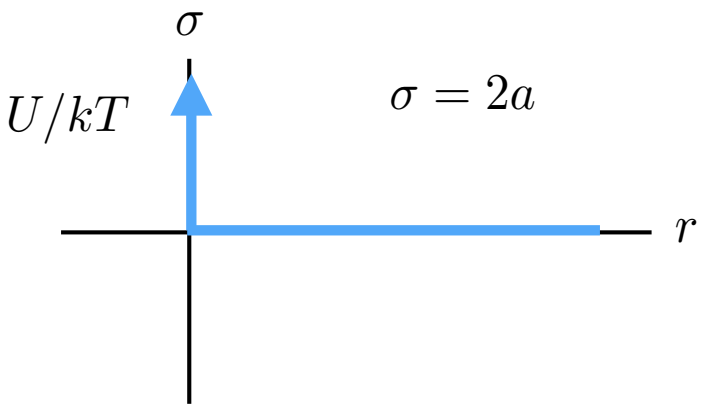
Model interactions - repulsion

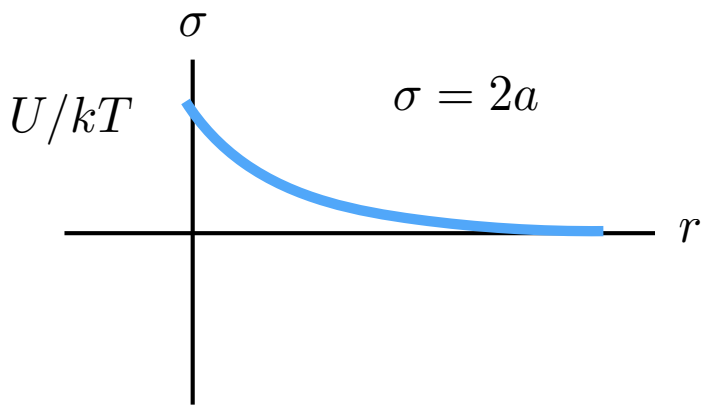
Hard sphere



$$U(r/2a)/kT = \begin{cases} \infty & r/2a \leq 1 \\ 0 & r/2a > 1 \end{cases}$$

Hard sphere Yukawa (HSY)

$$U(r/2a)/kT = \begin{cases} \infty & r/2a \leq 1 \\ \gamma \frac{e^{-kr/2a}}{r/2a} & r/2a > 1 \end{cases}$$



$$\gamma = \frac{l_B}{2a}\left(\frac{Ze^{k/2}}{1+k/2}\right)$$

Bjerrum length

$$l_b = e^2/\epsilon\epsilon_0 kT$$

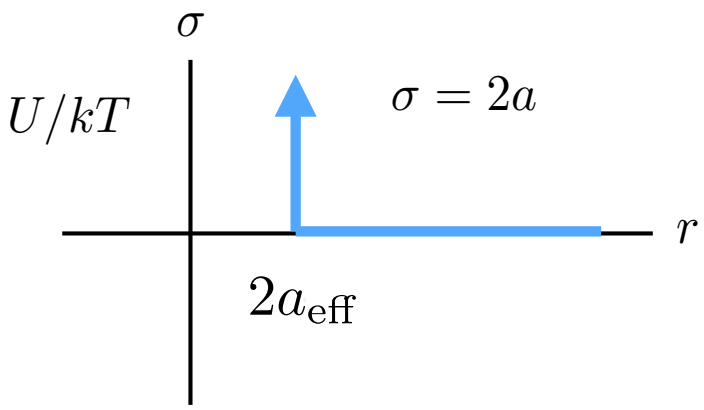
$$k^2 = \frac{l_B/2a}{1-\phi}\left[24\phi|Z| + 64\pi n_s a^3\right]$$

Z = number of charges on colloid

n_s = number concentration of monovalent (salt) co-ions

Model interactions - repulsion

Excluded annulus



$$U(r/2a)/kT = \begin{cases} \infty & r/2a \le a_{\text{eff}}/a \\ 0 & r/2a > a_{\text{eff}}/a \end{cases}$$

$$a_{\text{eff}} = \frac{h}{2} \approx \frac{1}{2\kappa} \ln \frac{\alpha}{\ln(\alpha/\ln\alpha)}$$

$$\alpha = \epsilon\epsilon_0 \Psi_0^2 a^2 \kappa \exp(2a\kappa)/kT$$

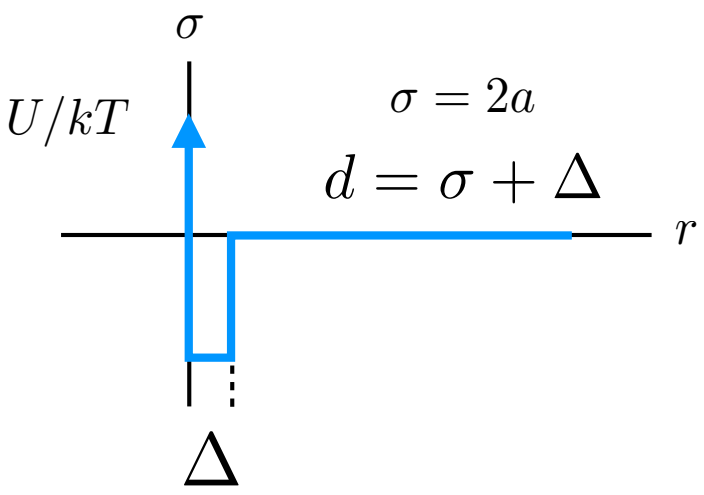
$\kappa =$ Debye length

$\Psi_0 =$ surface potential (V)

$$\phi_{\text{eff}} = \phi \left(\frac{a_{\text{eff}}}{a} \right)^3$$

Model interactions - attraction

Square well

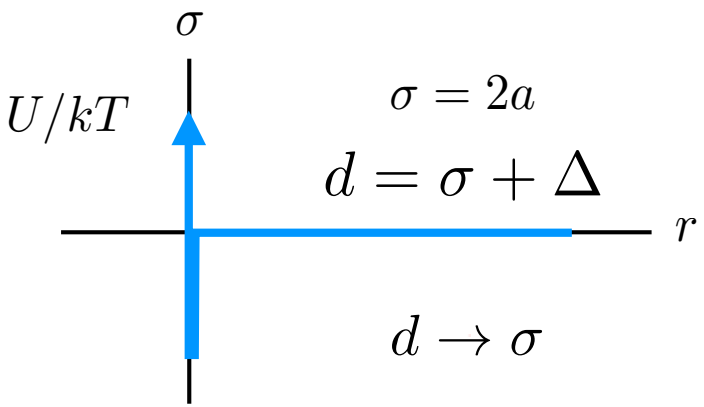


$$U(r)/kT = \begin{cases} \infty & r \le 2a \\ -\ln\left[\frac{d}{12\tau_B(d-2a)}\right] & 2a < r < d \\ 0 & r > d \end{cases}$$

$$d = 2a + \Delta$$

$$\tau_B = \frac{2a+\Delta}{12\Delta}\exp(-\varepsilon/kT)$$

Adhesive hard sphere (AHS) or sticky hard sphere



$$\exp\left[U(r)/kT\right] = \begin{cases} (d/12\tau_B)\delta(r-d) & r \le d \\ 1 & r > d \end{cases}$$