$dF =$
$-S\cdot$
$dT -$
$P\cdot$
$dV +$
$\mu\cdot$
dN
$U =$
$F +$
$T\cdot$
S
$0.45 <$
$T/T_c <$
1.13
T_c
$\eta =$
$\frac{N}{V}$
$\eta =$
$packingFraction$
$\Lambda =$

$$\frac{F}{N \cdot k \cdot T} = a^{IDEAL} + a^{HS} + \beta \cdot a_1^{SW} + \beta^2 \cdot a_2^{SW} \quad (1)$$

$$a^{IDEAL} = ln\left(n \cdot \Lambda^3\right) - 1 \quad (2)$$

$$a^{HS} = -ln(1 - 4 \cdot \eta) \quad (3)$$

$$a_1^{SW} = a_1^{VDW} \cdot g^{HS}(1; \eta_{eff}) \quad (4)$$

$$a_1^{VDW} = -4 \cdot \eta \cdot \epsilon \cdot (\lambda^3 - 1) \quad (5)$$

$$g^{HS}(1; \eta_{eff}) = \frac{1 - \eta_{eff}/2}{(1 - \eta_{eff})^3} \quad (6)$$

$$n_{eff} = c1 \cdot \eta + c_2 \cdot \eta^2 + c_3 \cdot \eta^3 \quad (7)$$

$$\left(c\right)_1{}^{c_2 c_3 =}\left(2\right)^{.25855-1.503490.249434-0.6692701.40049-0.82773910.1576-15.04275.30827\times}\left(1\right)^{\lambda\lambda^2} \quad (8)$$

$$a_2^{SW} = \frac{1}{2} \cdot \epsilon K^{HS} \eta \cdot \frac{\partial a_1^{SW}}{\partial \eta} \quad (9)$$

$$K^{HS} = \frac{(1 - \eta)^4}{1 + 4 \cdot \eta + 4 \cdot \eta^2} \quad (10)$$

$$Z = Z_{ideal} \cdot Z_{HS} \cdot Z_{disp}$$

$$Z_{ideal} = Z_{ideal}^{SAFTVR}$$

$$Z_{HS} = e^{-S_{HS}/k}$$

$$Z_{disp} = \frac{Z_{interaction}}{Z_{HS}} = \frac{\sum_i \alpha \cdot D(E_i) \cdot e^{-\beta \cdot E_i}}{\lim_{T \to \infty} \sum_i \alpha \cdot D(E_i) \cdot e^{-\beta \cdot E_i}} = \frac{\sum_i D(E_i) \cdot e^{-\beta \cdot E_i}}{\sum_i D(E_i)}$$

S_{HS}
$T =$
∞
$P_{success}$
$\Delta S_{HS} =$
$k\cdot$
$ln(P_{success})$
S_{HS} $\frac{}{N! \sum_i e^{-\beta \cdot E_i} 11 = \frac{1}{N!} \int \cdots \int e^{-\beta \cdot [\{P_1^2/2m + P_2^2/2m + \ldots\} + V(\vec{R_1}, \vec{R_2}, \ldots)]} d\vec{P_1} \cdot d\vec{P_2} \cdots d\vec{P_N} \cdot d\vec{R_1} \cdot d\vec{R_2} \cdots d\vec{R_N}}$
V^N / V^N
$ideal\cdot$
$\frac{1}{V^N}\cdot$
$\int \cdot\cdot$

$$andZ_{disp} = \frac{Z_{interaction}}{Z_{HS}}$$
(19)

T_0
T_0
$T0$
$F_{ideal} =$
$U_{ideal} -$
$T \cdot$
S_{ideal}

$$U_{ideal} = 3/2 \cdot N \cdot k \cdot T$$
(20)

$$S_{ideal^*} \approx k \cdot N \left(ln \left[\frac{V}{N} \left(\frac{4 \cdot \pi \cdot m}{3 \cdot h^2} \cdot \frac{U}{N} \right)^{3/2} \right] + \frac{5}{2} \right)$$
(21)

$$S_{ideal} = k \cdot N \left(ln \left[V \cdot N!^{-1/N} \left(\frac{4 \cdot \pi \cdot m}{3 \cdot h^2} \cdot \frac{U}{N} \right)^{3/2} \right] + \frac{3}{2} \right)$$
(22)

$T \rightarrow$
∞

$$Z_{exc} = Z_{HS} \cdot Z_{disp} \Rightarrow$$
(23)

$$F_{exc} = -k \cdot T \cdot ln(Z_{exc}) = -k \cdot T \cdot ln(Z_{HS}) - k \cdot T \cdot ln(Z_{disp}) \Rightarrow$$
(24)

$$S_{exc.\infty} = \lim_{T \to \infty} - \left(\frac{\partial F_{exc}}{\partial T} \right)_{V,N} but \lim_{T \to \infty} Z_{exc} = constant \Rightarrow$$
(25)

$$S_{exc.\infty} = -k \cdot ln(Z_{HS.\infty}) - k \cdot ln(Z_{disp.\infty})$$
(26)

$$butZ_{HS}isalsoconstantandZ_{disp.\infty} = \frac{Z_{interaction.\infty}}{Z_{HS}} = Z_{HS}/Z_{HS} = 1 \Rightarrow$$
(27)

$$S_{exc.\infty} = -k \cdot ln(Z_{HS}) - k \cdot ln(1) = -k \cdot ln(Z_{HS}) \Rightarrow$$
(28)

$$Z_{HS} = e^{-S_{exc.\infty}/k}$$
(29)

$T \rightarrow$
∞

$$F = U - T \cdot S \Rightarrow S = (U - F)/T \approx -F/T = k \cdot ln(Z)$$
(30)

$$letZ_{small} = partitionfunctionofthesmallerbox$$
(31)

$$letZ_{big} = partitionfunctionofthebiggerbox$$
(32)

$$\Delta S = S_{small} - S_{big} = k \cdot ln(Z_{small}) - k \cdot ln(Z_{big}) = k \cdot ln(Z_{small}/Z_{big})$$
(33)

Z_{big}
ΔS
Z_{small}
Z_{valid}

$$letZ_{big} = Z_{valid} + Z_{invalid}$$
(34)

$$noteZ_{small}mapsintoZ_{valid} \Rightarrow Z_{small} = \alpha \cdot z_{valid}forsomeconstant\alpha$$
(35)

α
α
Z_{small}