

Variational Nonequilibrium Statistical Mechanics

Wintersemester 2018/19
Lectures Prof. M. Schmidt
Tutorials PD Dr. Daniel de las Heras



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Blatt 7 - Hausaufgabe

Übung am 14. December 2018

Aufgabe 1: Hard rods in the grand ensemble

Consider a system of one dimensional hard rods of length σ confined in a line segment of length L . Calculate the grand canonical density profile for the case $\bar{N} = 1$ and $2\sigma < L < 3\sigma$. Compare the result to the canonical density profile.

Aufgabe 2: Gibbs' inequality

Proof that $x \ln(x) \geq x - 1$

Aufgabe 3: Zero dimensional cavity

A classical particle is confined in a narrow cavity which cannot hold more than one particle at once. Using the grand ensemble $\Omega = F - \mu\bar{N}$, show that the excess (over ideal gas) free energy is

$$\beta F_{\text{exc}} = \beta(F - F_{\text{id}}) = \bar{N} + \ln(1 - \bar{N})(1 - \bar{N}) \quad (1)$$

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Aufgabe 4: Functional derivative

Calculate the following functional derivative

$$\frac{\delta^3 \Omega[v_{\text{ext}}]}{\delta v_{\text{ext}}(\mathbf{r}) \delta v_{\text{ext}}(\mathbf{r}') \delta v_{\text{ext}}(\mathbf{r}'')} \quad (1)$$