# Quantenmechanik auf einem Zufallsgitter

Andreas Windisch

Vortrag zum *Projektpraktikum*
20. Mai 2010

# Berechnung der Korrelationsfunktion

**Korrelationsfunktion**

$$\langle x(\tau)x(0)\rangle = \overline{x_i x_{i+m}}, \quad \tau = ma$$

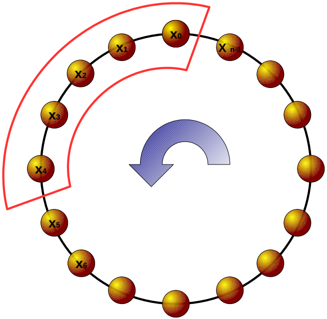



Figure: Periodische Randbedingungen und Korrelationsfunktion, $\tau$=4

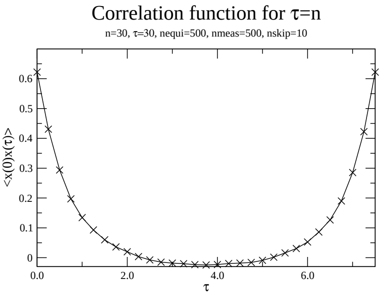



Figure: Korrelationsfunktion für $\tau$=n

# Plots der Korrelationsfunktion

## Berechnung der Energie

$$E_0 = m\omega^2 \langle x^2 \rangle$$

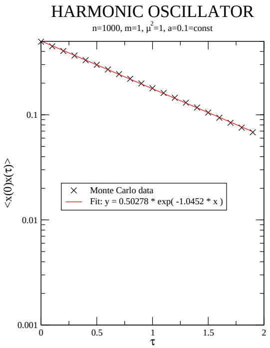



Figure: Korrelationsfunktion für konstante Gitterabstände

## Grundzustandsenergie

$$\begin{aligned} E_0 &= \mu^2 \langle x^2 \rangle \\ E_0 &= 1 \cdot 0.50278 = 0.50278 \\ E_1 &- E0 = 1.0452 \\ E_1 &= 1.0452 + E_0 = 1.54798 \end{aligned}$$

Analytische Lösung (Kontinuumslimes):

$$\begin{aligned} E_0 &= \mu^2 \langle x^2 \rangle = \mu^2 \frac{1}{2} \frac{\hbar}{m\omega} = \\ &= 1 \cdot \frac{1}{2} = \frac{1}{2} \\ E_1 &= \hbar\omega(1 + \frac{1}{2}) = \frac{3}{2} \end{aligned}$$

# Anharmonisches Potential

## Potential

$$V(x) = x^4 - 2f^2x^2 + f^4$$

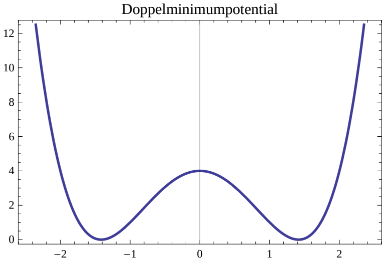



Figure: Potential $V(x)$

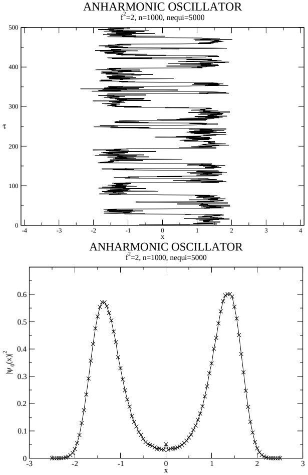
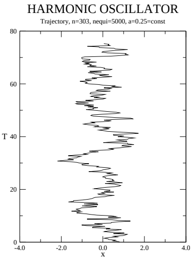
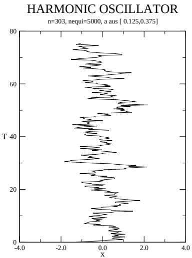
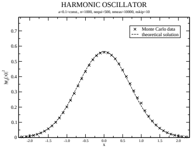


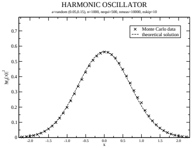

Figure: Trajektorie und Absolutbetragsquadrat für festen Gitterabstand

# Was passiert bei zufälligem Gitterabstand?




**Direkter Vergleich**

Links fester und rechts variabler Gitterabstand

# Vergleich der Ergebnisse

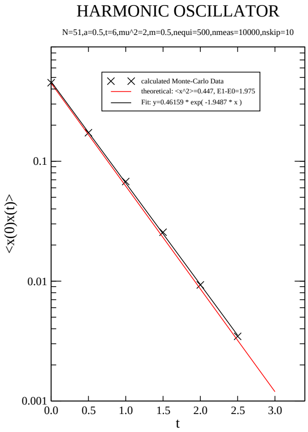



Figure: Korrelationsfunktion für festen Gitterabstand

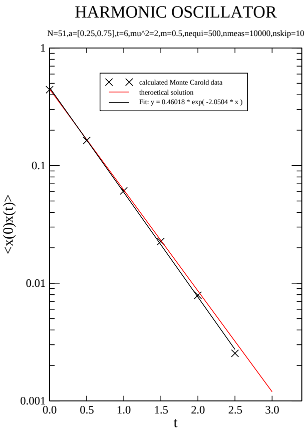



Figure: Korrelationsfunktion für variablen Gitterabstand

# Literatur


M. Creutz and B. Freedman.
A statistical approach to quantum mechanics.
*Annals of Physics*, 132, 1981.

Kohlfuerst.
Bachelor thesis, 2010.

C.B. Lang and Ch. Gattringer.
*Quantum Chromodynamics on the Lattice: An Introductory Presentation*.
Springer, 2010.

R. MacKenzie.
Path integral methods and applications.
*arXiv:quant-ph/0004090V1*, 2000.