Theoretical Statistical Physics **WS 2010/11**

(Prof. C. Wetterich)

I Foundations of Statistical Physics

1. Introduction

a.) From microphysics to macrophysics

b.) Macroscopic laws and simplicity

c.) Fundamental laws are of probabilistic nature

2. Basic concepts of Statistical Physics

a.) Probability distribution and expectation values

b.) Reduced systems (subsystems)

c.) Probabilistic observables

d.) Quantum statistics and density matrix

e.) Microstates

f.) Partition function for one particle in a box

g.) Probability distribution for continuous variable

h.) Probability density for energy

i.) Number of one-particle states per momentum interval

j.) Correlation functions

3. Systems with many states or particles

a.) Chain of N lattice sites

b.) Uncorrelated probability distributions

c.) Statistical ensembles

d.) Gauss distribution

e.) Thermodynamic limit

4. Equilibrium ensembles

a.) Microcanonical ensemble

b.) Canonical ensemble

c.) Grand canonical ensemble

5. Thermodynamics

a.) Thermodynamic potentials

b.) Reversible and irreversible processes

II Statistical systems

6. Ideal quantum gases

a.) Occupation number basis

b.) Partition function for grand canonical ensemble

c.) Occupation numbers for bosons and fermions

d.) Photon gas

e.) Fermi gas

f.) Free non-relativistic bosons

g.) Classical ideal gas

h.) Bose-Einstein condensation

7. Gas of interacting particles

a.) Interactions and complexity

b.) Real Gases

c.) Mean field approximation

d.) Equation of state

e.) Specific heat for real gas

f.) Equipartition