

Quantum Theory of Condensed Matter

Prof. John Schliemann
Dr. Andrea Donarini

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Sheet 5

1. Non-interacting magnets: Brillouin function.

Consider a system of non-interacting particles of magnetic moment μ in a magnetic field of the form $B = (0, 0, B_z)$ and in thermal equilibrium at temperature T . Calculate the magnetic susceptibility for the system both in the classical and quantum case. For the quantum case consider particles of spin S . Do you recover the classical case in the limit $S \rightarrow \infty$?

2. One dimensional Ising model for ionic ferromagnets

Consider a ionic one dimensional ferromagnet consisting of a set of local moments. The total energy of the system is given by the expression:

$$E(\{S_i\}) = -J \sum_{\langle i,j \rangle} S_i S_j - \mu B \sum_i S_i$$

where $\{S_i\}$ represents a particular configuration of the system, S_i can assume only the values ± 1 and we assume periodic boundary conditions *i.e.* $S_{N+1} = S_1$. B is the magnetic field.

- Calculate the canonical partition function for the system.
- Calculate the average magnetization for the system at temperature T and make a sketch of the magnetization versus the magnetic field for different temperatures.

Frohes Schaffen!