BA

**Prof. Dr. Maria-Roser Valentí**

# BACHELOR Arbeitsthemen

## Description of project nr. 4

***Heisenberg model.***
***Derivation and analysis of the model for various spin systems.***

1) Start with the Schrödinger equation for 2 electrons and solve in the Heitler-London approximation. Analyse the meaning between the singlet and the triplet state.

2) Concept of localized magnetic moments in contrast to itinerant magnetic moments

3) Concept of:
   Direct exchange, superexchange, double exchange

4) Simpler models:
   Ising Model, XY Model
   In which cases are these models exactly solvable?

5) Solve the Heisenberg model analytically for various finite systems

6) Historical background

7) Spin-wave excitations

8) Variational approach

**Literature**

Patrik Fazekas, *Lecture Notes on Electron Correlation and Magnetism*. World Scientific (2003)

N.W. Ashcroft and D. Mermin, *Solid State Physics*, HRW int. ed.

**Articles**

P.W. Anderson, Phys.Rev. **115**, 2 (1959)

W. Wernsdorfer et al., Phys. Rev. Lett. **96**, 057208 (2006)

Ch. Schröder et al. Phys. Rev. Lett, 94, 017205 (2005)