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UNIVERSITÉ DE FRIBOURG
UNIVERSITÄT FREIBURG

DÉPARTEMENT DE PHYSIQUE
FACULTÉ DES SCIENCES ET DE MÉDECINE

Travaux d'initiation à la recherche : 4 juin 2021, 14h15, salle 0.51

Speaker: Irine Rusetski

Title: **Analytical Solution and Numerical Application of the Ising Model**

Abstract: The Ising Model of a ferromagnet only has exact solutions in 1D and in a 2D non-zero field square lattice. The objective of this work was to familiarize with the methods of solving the Ising model, both analytic and numerical. For the 1D Ising model, the transfer matrix approach was used to solve the problem in both zero and non-zero fields analytically. In the case of a 2D square lattice in a zero field, an implementation of the Metropolis was used to analyze the system's magnetization. The results were compared with Lars Onsager's analytic solution in the thermodynamic limit.

Speaker: Matthias Murray

Title: **Hard sphere perturbation methods in liquid theory**

Abstract: This work in classical statistical mechanics explores some tools to get equations of state in the low density limit. It makes use of the hard sphere potential to better understand corrections made to results from the free gas model such as in the Virial expansion or the Van der Waals equation. Some emphasis is brought to the radial distribution function $g(r)$, which corrects for the non-independence between molecules in an interacting medium.

Two equations describing energy and pressure of the system are derived using this distribution function for homogeneous and translational invariant fluids. A trivial example is given, in which it is shown formally that the total energy of the hard spheres system is equivalent to that of the ideal gas. The two first virial coefficients are then also determined analytically, which in most models is not the possible. Then, the Van der Waals equation is proven making use of functional line integration. The parameter b describing the free volume of the system is characteristic of the hard sphere model and the attractive parameter a is also given explicitly. This finally allows us to better understand the liquid-gas phase transition which is indirectly predicted by Van der Waals' model.