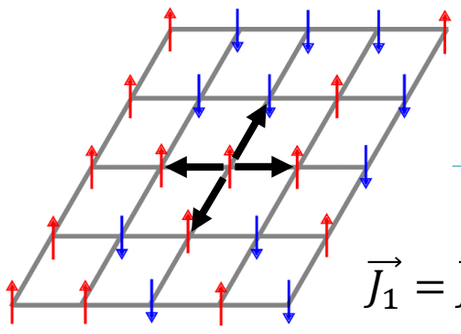
PHASE TRANSITION OF 2D ISING MODEL WITH $J_x - J_y - J_a - J_b$ INTERACTION.

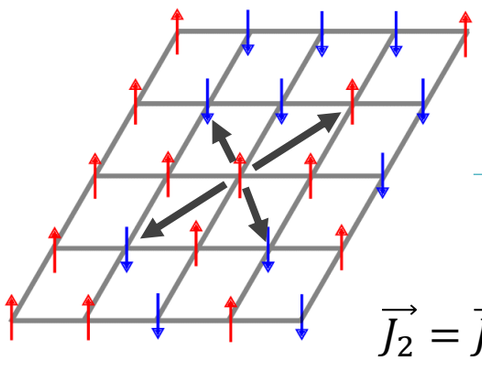
[2]Nguyen Vo Nguyen Huy, [1]Nguyen Duc Dung, [3]Duong Xuan Nui, [1]Dao Xuan Viet
[1]International Training Institute for Materials Science, School of Materials Science and Engineering, Hanoi University of Science and Technology, Hanoi, Viet Nam
[2]Faculty of Engineering Physics, Hanoi University of Science and Technology, Hanoi, Viet Nam
[3]Faculty of Mechanical Engineering, National University of Civil Engineering, Ha Noi, Vietnam
*Contact: viet.daoxuan@.hust.edu.vn

MOTIVATION



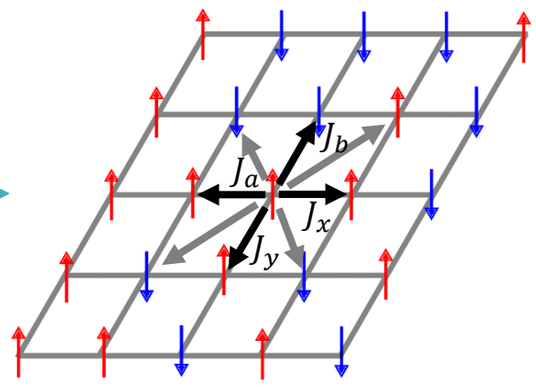
$\overrightarrow{J_1} = \overrightarrow{J_x} + \overrightarrow{J_y}$

2D Ising first class interaction model
(Nearest neighbour – NN)

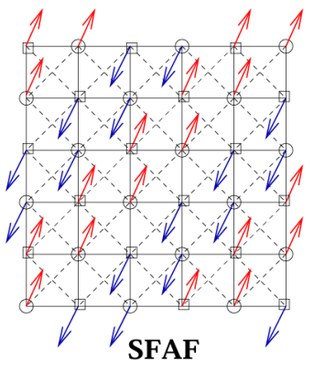


$\overrightarrow{J_2} = \overrightarrow{J_a} + \overrightarrow{J_b}$

2D Ising second class interaction model
(Next-nearest neighbour – NNN)

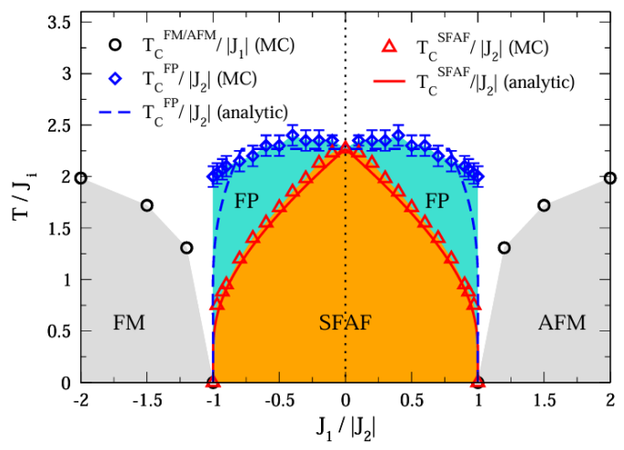


2D Ising model
with $J_x - J_y - J_a - J_b$ interaction



Superferro- antiferromagnetic configuration
appear in NNN interaction

[Gennady Y. Chitov.PhysRevB (2013)]



Phase diagram with changeable
$J_a = -J_b$ and J_1 can be choosen.

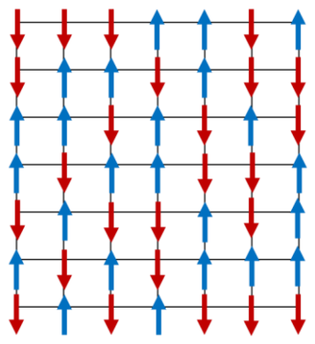
State of magnetic model with $J_x - J_y - J_a - J_b$ interaction when $J_x = -J_y$ and $J_a = -J_b$?

ACTIVITIES

Hamiltonian

$$\mathcal{H} = J_x \sum_{nn^x} s_i s_j + J_y \sum_{nn^y} s_i s_j + J_a \sum_{nnn^a} s_i s_j + J_b \sum_{nnn^b} s_i s_j$$

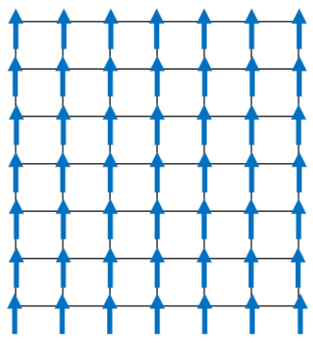
- J: Exchange interaction between ith and jth spin.
- s = ±1 (spin up or down).
- $s_i s_j$: nearest neighbour.



Random spins configuration

Use Metropolis algorythm to equilibrate the system

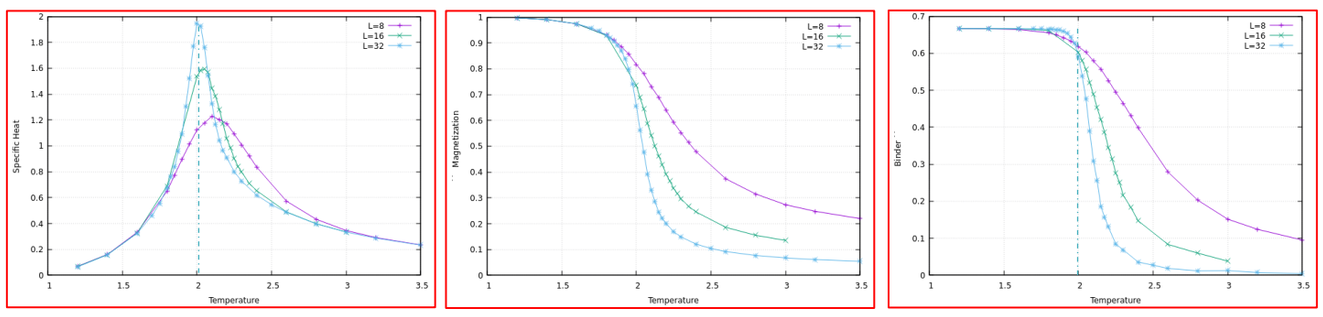
From equilibrium configurations, calculate physical quantity such as: magnetization, energy, specificheat...

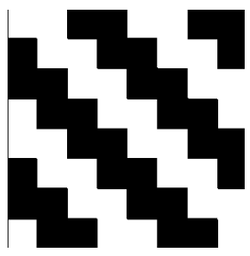


Equibrium configurations

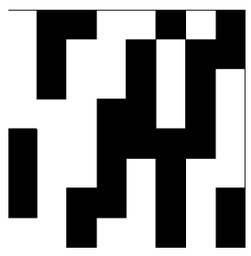
RESULTS

Simulation results

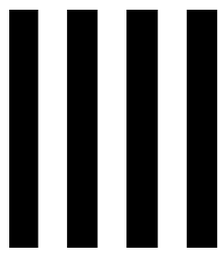




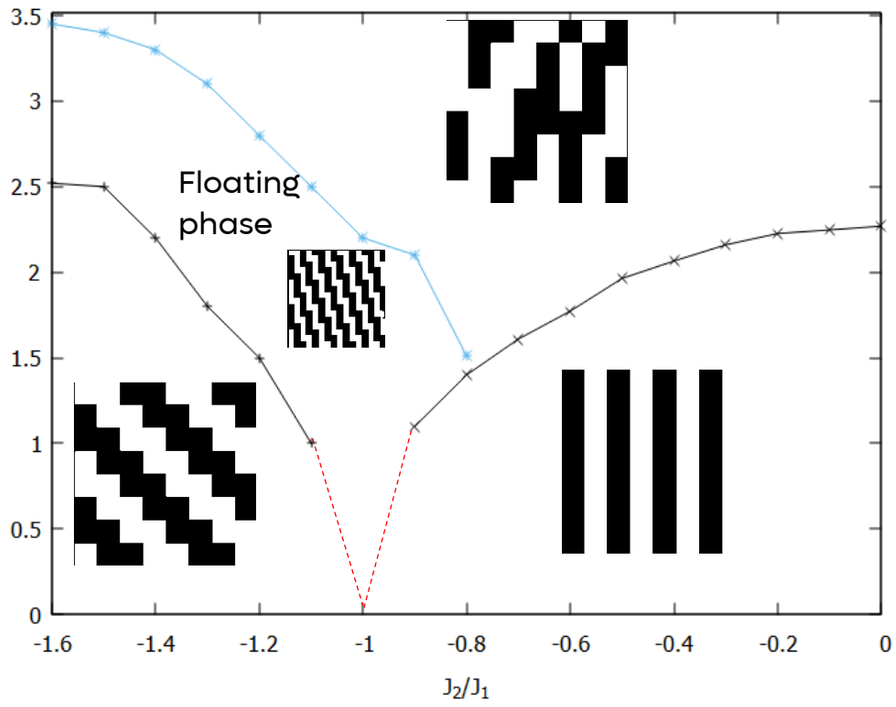
Superferro-antiferromagnetic



Paramagnetic



Superferromagnetic



Phase diagram of 2D Ising model
with $J_x - J_y - J_a - J_b$ interaction

CONCLUSION AND DISCUSSION

- Estimated the phase transition graph of 2D Ising model with $J_x - J_y - J_a - J_b$ interaction.
- Calculated exact critical point of phase transition.

Discussion: Is there any existance of another state in floating phase?