

# Phases, order parameters, phase transitions, and all that

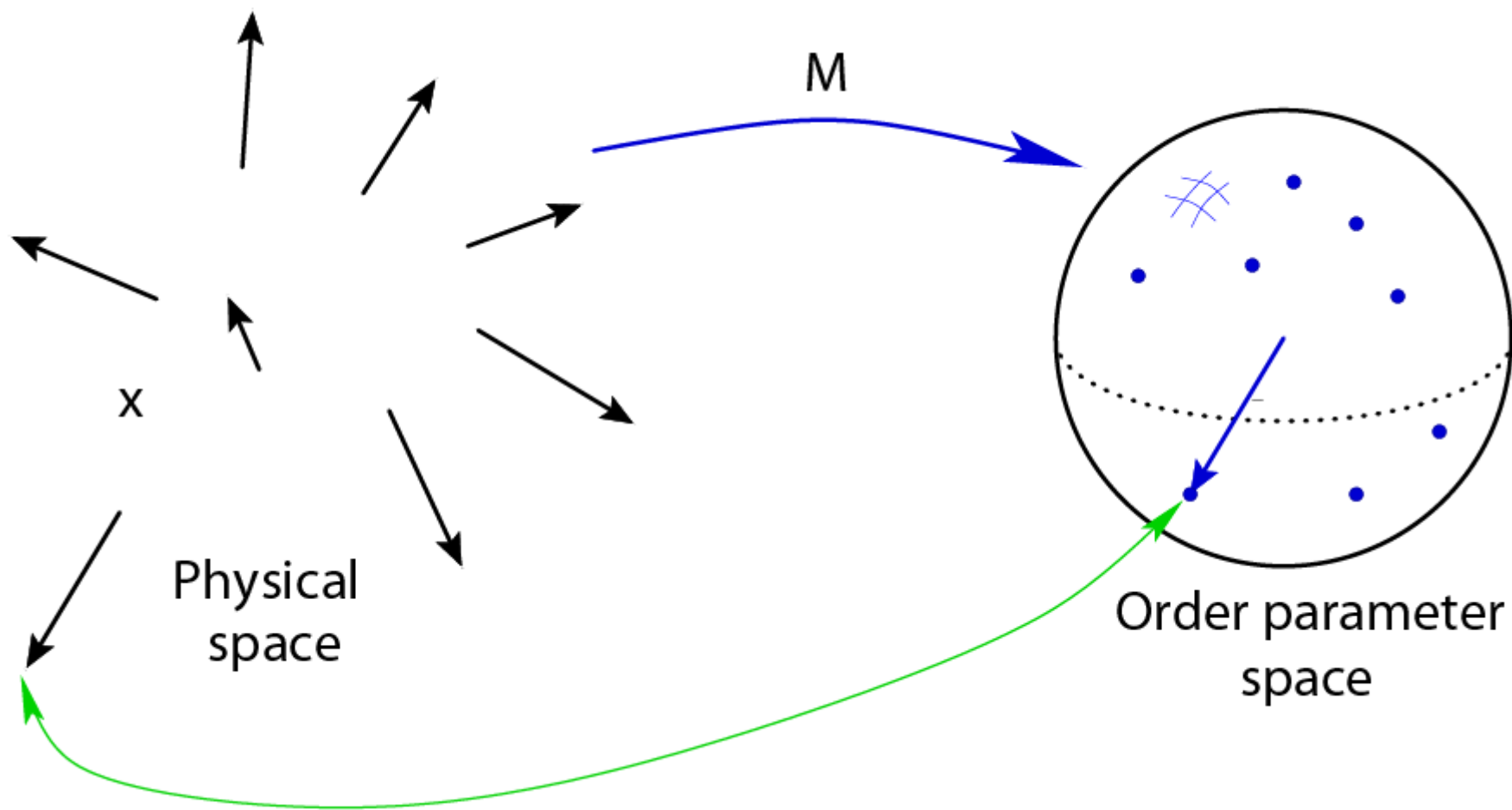
Mikhail Tamm, Moscow State University

## Keywords:

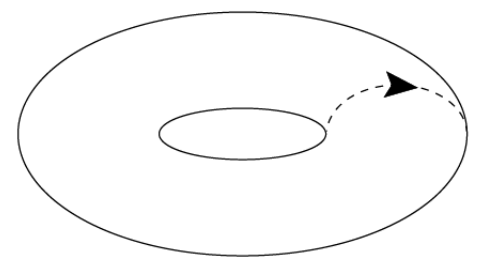
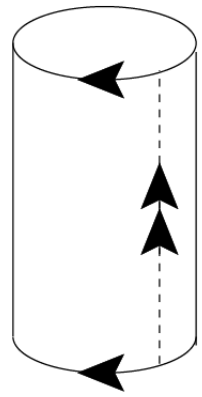
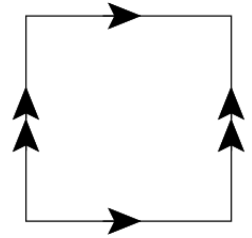
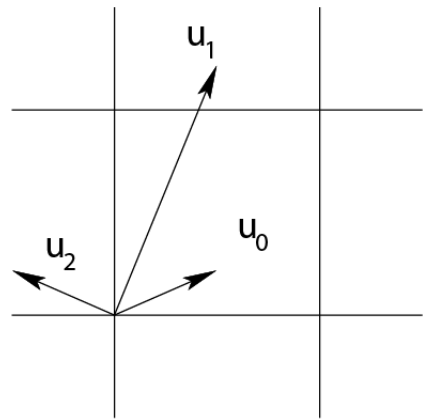
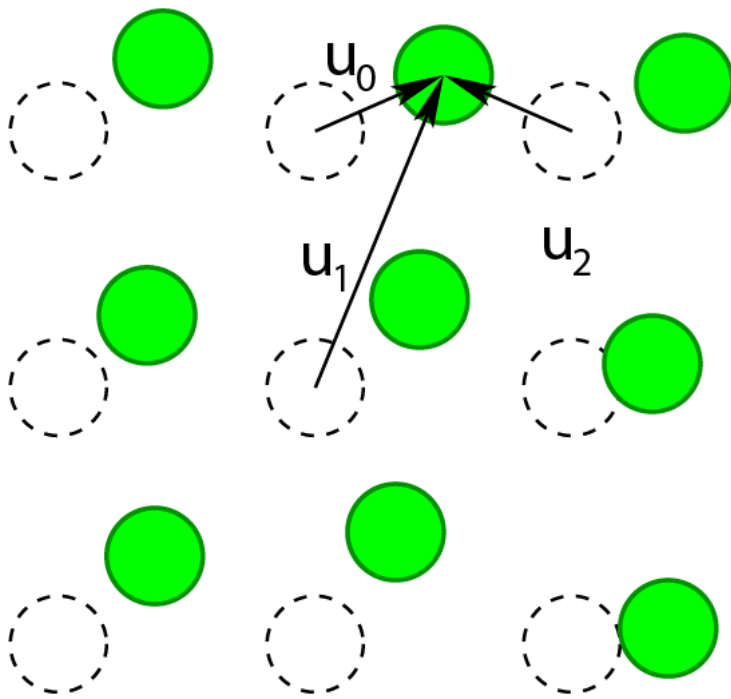
- phases;
- spontaneous symmetry breaking;
- order parameters;
- phase transitions – abrupt and continuous;
- Landau free energy;
- hysteresis;
- criticality, scale-free fluctuations, and universality;
- power laws and scaling functions.

**FINITE SIZE EFFECTS!**

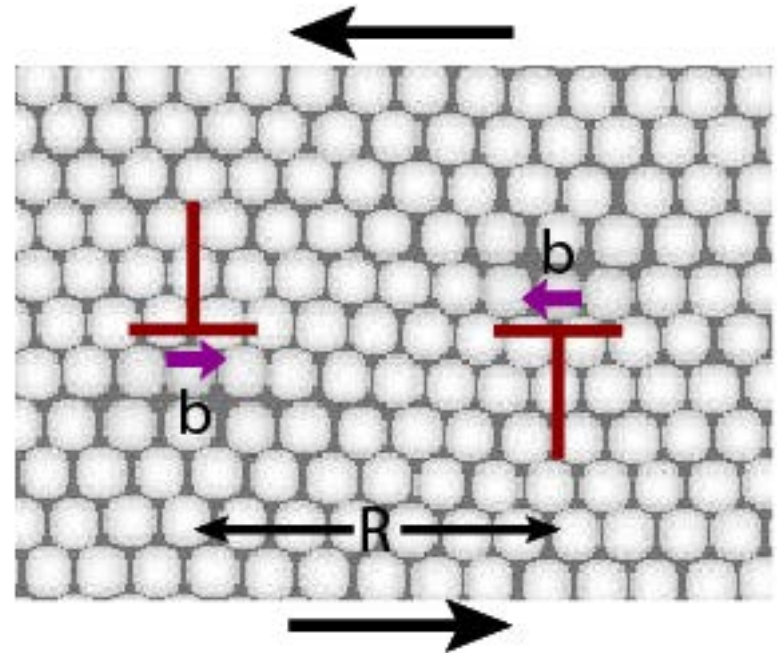
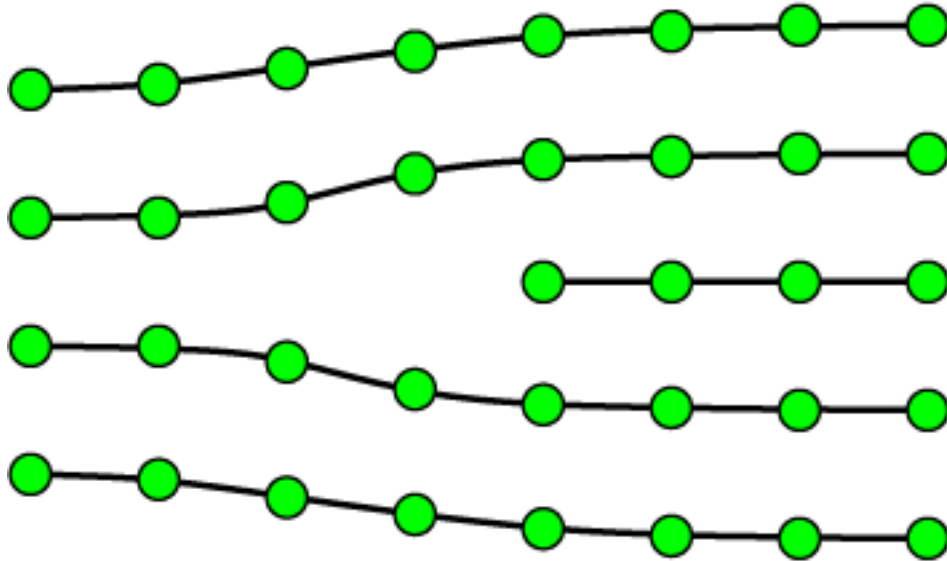
# Order parameter space



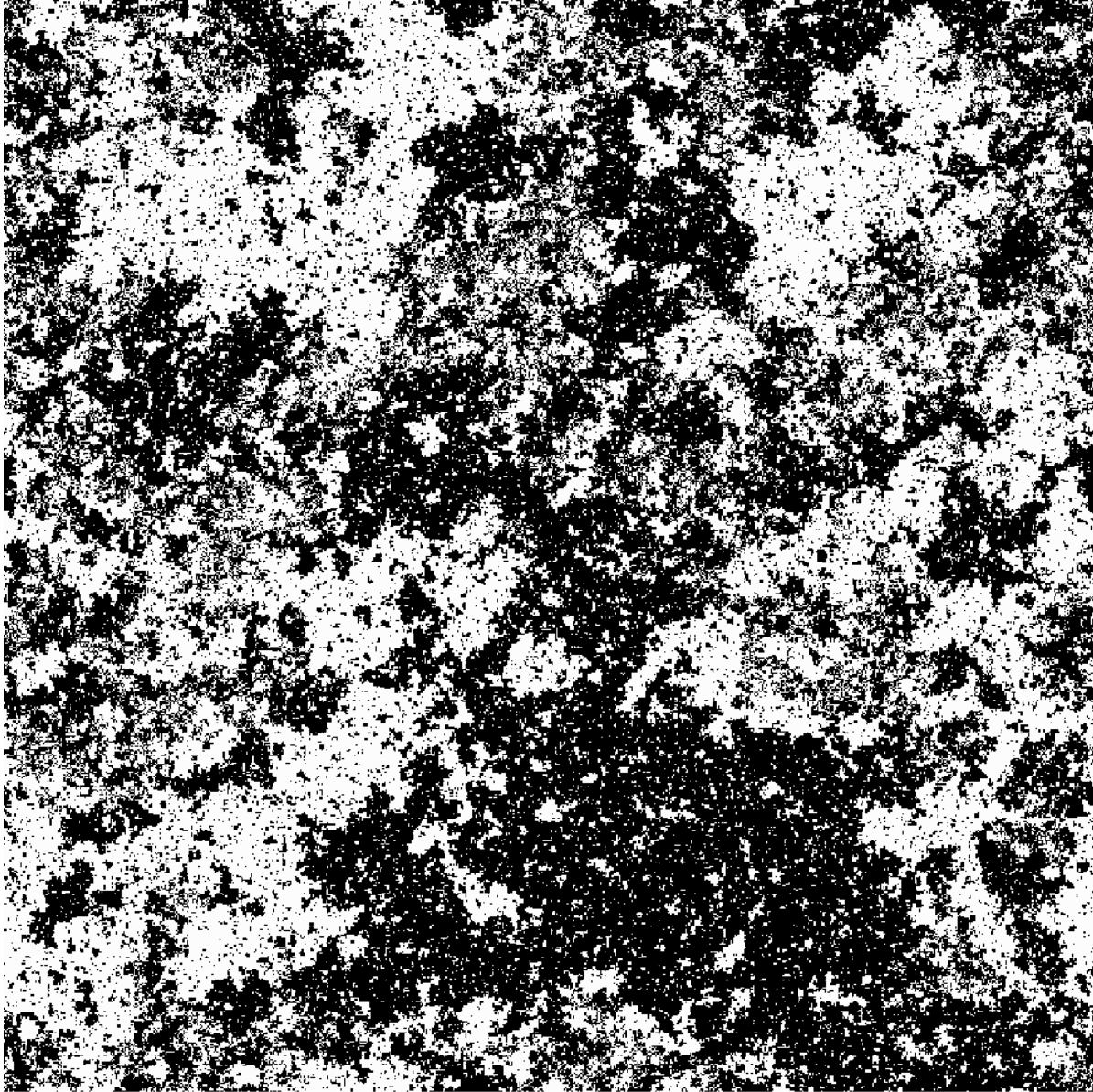
# Order parameter for a 2D crystal



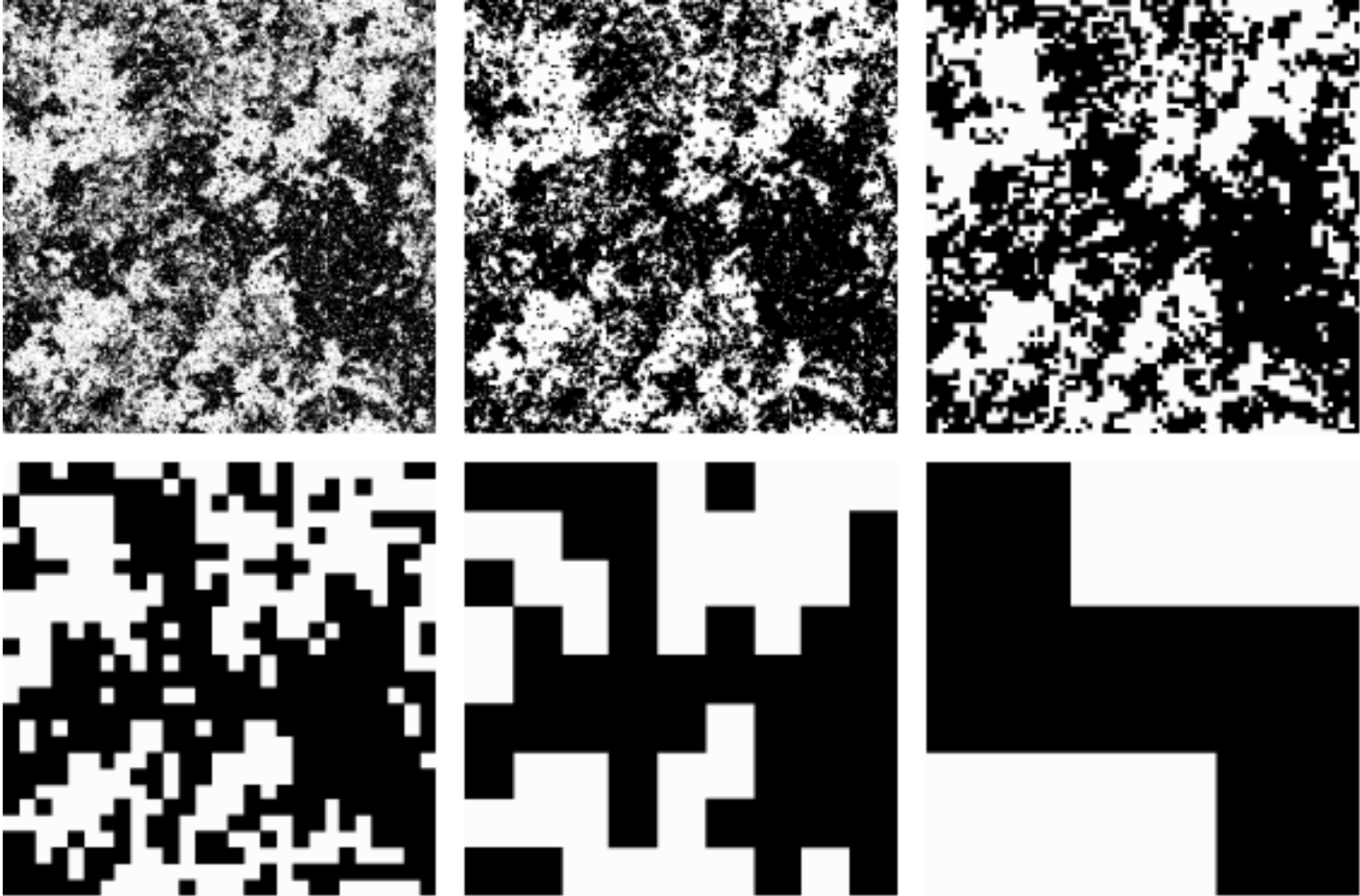
# Dislocation in a 2D crystal



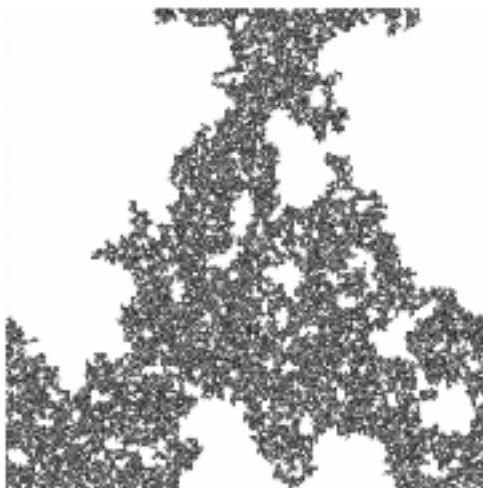
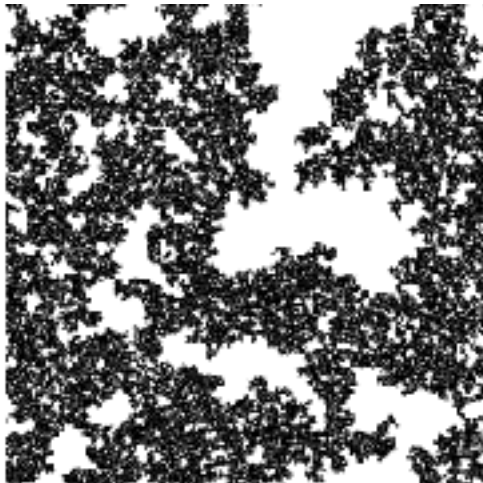
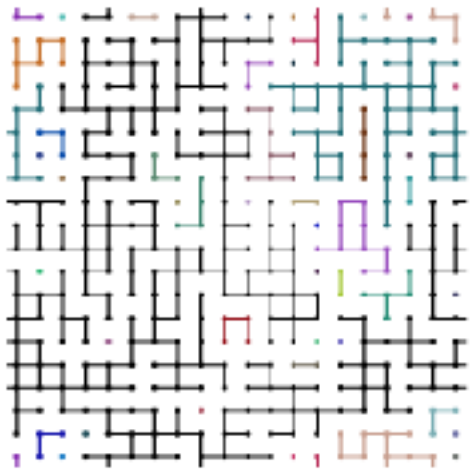
# Critical fluctuations



Criticality: fluctuations on all scales

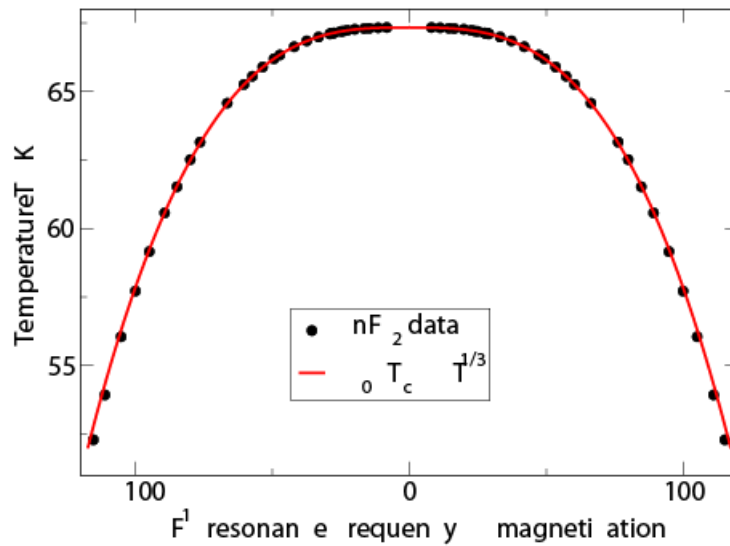
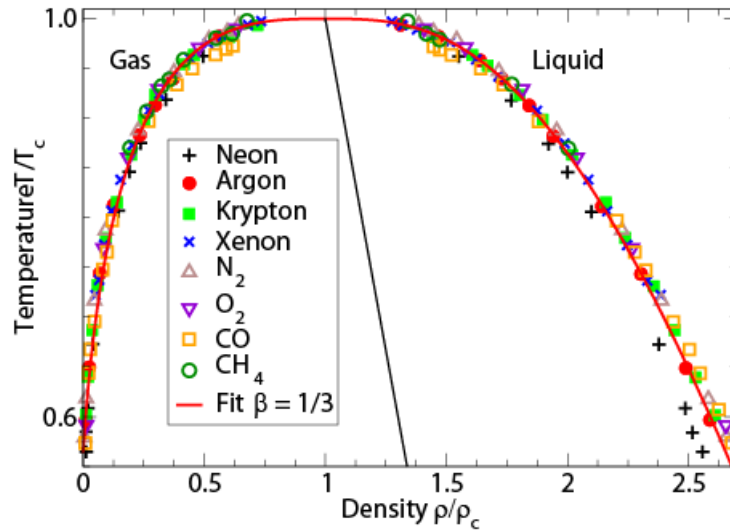


# Universality in percolation





# Universality at the critical point



# Scaling collapse

