Centre de Physique Théorique: Physique des particules

Stage proposed by Savvas Zafeiropoulos (savvas.zafeiropoulos@cpt.univ-mrs.fr)

In this M2 stage project we will investigate the first-order phase transitions of the q-state Potts models with q = 5; 6 and 7 on two-dimensional square lattices, using Monte Carlo simulations and data analysis techniques including reweighting. The motivation comes from misleading strong hints from standard data-collapse procedures for a second order phase transition (the so called `pseudo-critical' behavior) in setups in which the Potts model is known to feature, in fact, a weekly first order phase transition.
The fact that the transition is of first order is only identified correctly, also according to recent literature, by looking at trends in the `pseudo-critical' exponents as a function of the system size. The main task is to check the latter statement by using the standard set of tools normally employed for identifying the order of phase transitions in QCD-like setups. The student must autonomously equip herself/himself with all necessary simulation and analysis programs.

The basic literature for this work is given by the following article:
Detecting Signals of Weakly First-order Phase Transitions in Two-dimensional Potts Models
Shumpei Iino, Satoshi Morita, Naoki Kawashima, Anders W. Sandvik (Jan 9, 2018)
Published in: J.Phys.Soc.Jap. 88 (2019) 3, 034006 • e-Print: 1801.02786 [cond-mat.stat-mech]

For general background knowledge on critical phenomena we recommend:

Statistical Mechanics
by Kerson Huang
John Wiley & Sons; 2. edition (29 April 1987)

Regarding the methods and algorithms we recommend the following excellent books:

Monte Carlo Methods in Statistical Physics
by G. T. Barkema and Mark Newman
Clarendon Press; 1st edition (April 15, 1999)

as well as the book on **Computational Physics** by Konstantinos Anagnostopoulos
that can be found here

Markov Chain Monte Carlo Simulations and Their Statistical Analysis
by Bernd Berg
World Scientific