Spatially heterogeneous phases in multi-layer p-spin models

Yuki R. Hamano[1], Hajime Yoshino[1,2]
(1) Dept. of Physics, The Univ. of Osaka (2) D3 Center, The Univ. of Osaka

Purpose: Wetting phenomena have been extensively studied in ferromagnets(FM), but less so in spin glasses (SG). We propose a family of multi-layer model for a mean-field treatment.

Methods: We use replica theory in the dense limit [1, 2] to obtain analytic equations of state that are solved numerically. Using replica exchange Monte Carlo(REMC) algorithm [3, 4], we perform large-scale simulations of finite-connectivity model to support the theory.

Results: The theory exhibits a rich wetting phenomenology for both FM and replica symmetry broken (RSB) SG models: new stable branches of solutions, sometimes without a bulk counterpart, are identified [5]. The REMC simulations confirm the presence of spatially heterogeneous RSB phases in the corresponding finite-connectivity SG models[6].

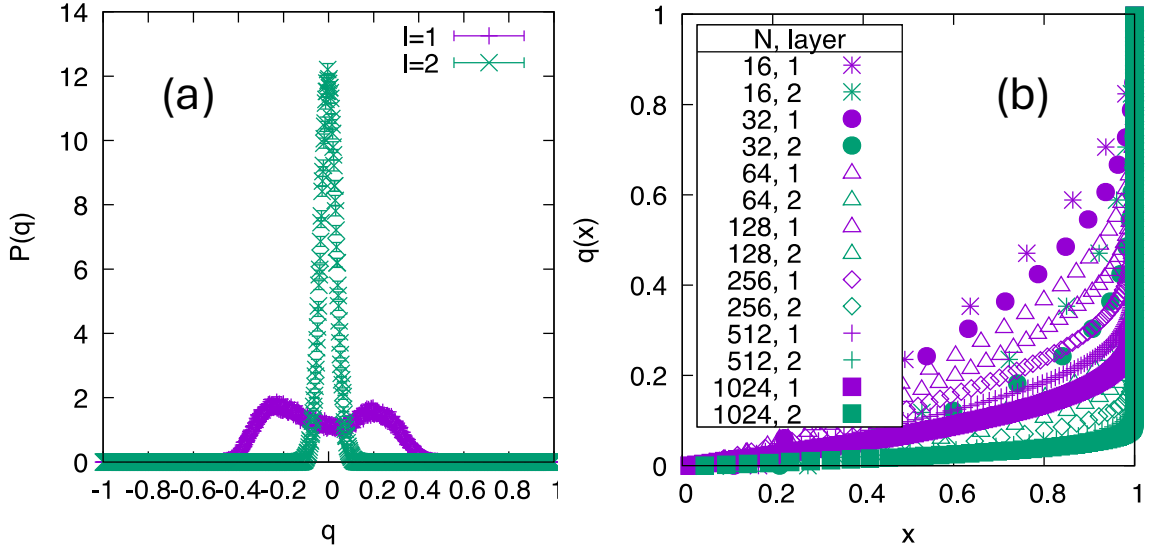

Fig.: Overlap distribution P(q) and Parisi function q(x) of a p=2+2, L=3 system with connectivity c=16 and # of particles per layer N=1024. (a) Spatially heterogeneous RSB: layer 1 in full RSB while layer 2 in 0-RSB. (b) Spatial heterogeneity holds in finite-connectivity model in the thermodynamic limit.

System: **SQUID General Purpose CPUs**
Node-hours (CPU): 30.73
Memory (total HDD): 1.4 TB
Parallelization (MPI): 20 CPUs

[1] H. Yoshino, SciPost Phys. 4, 040 (2018)
[2] H. Yoshino, SciPost Phys. 2, 005 (2020)
[3] K. Hukushima, K. Nemoto, JPSJ 65,16(1995)
[4] K. Hukushima et al., JPSJ 67, 1 (1998)
[5], [6] Y. Hamano, H. Yoshino, in preparation.