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Quantum wetting transition in the cluster Ising model

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The wetting transition in the one-dimensional cluster Ising model with opposite boundary fields is studied. Tuning one boundary field while fixing another leads to the occurrence of phase transitions, where the transition points depend on the cluster coupling. Furthermore, the phase diagram is divided into three regions with different phase transition. For weak and strong cluster coupling, the phase transition is continuous and belongs to the same universality of transverse Ising model with boundary fields. For intermediate cluster coupling, the phase transition is first order. In the strong cluster coupling region, the critical region becomes exponentially small andthe asymptotic behavior is absent even for lattice size up to 104. A numerical method to solve the energy gap and the
correlation length is proposed on an infinite long spin chain. With this method, one can get the critical behavior as close to the critical point as possible
provided that the numerical accuracy is high enough. In the light of this method, we clearly show that there is a preasymptotic regime in which the apparent critical exponents depend on the cluster coupling. Moreover, we obtain the accurate energy gap exponent ⌧⌧ and the correlation length exponent ⌧ in the asymptotic critical region.

Primary authors: Dr 胡, 坤; 邹, 银涛 (华中师范大学)

Presenter: 邹, 银涛 (华中师范大学)

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