CRITICALITY IN DISORDERED TRIANGULAR LATTICE

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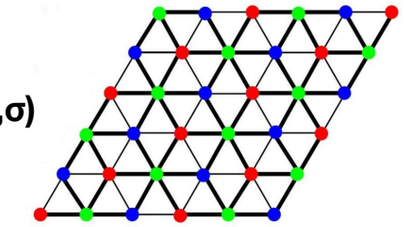
RANDOM FIELD ISING MODEL (T=0)

$$H = -J\sum_{i,j} c_i s_i c_j s_j - \sum_i h_i c_i s_i - h\sum_i c_i s_i$$

J : ferromagnetic interaction
s_i = ±1 (Ising Spins)
h_i : random field from Gaussian dist N(0,σ)
c_i : 1/0 if site present/absent
h : external field
Dilute one sub lattice with c

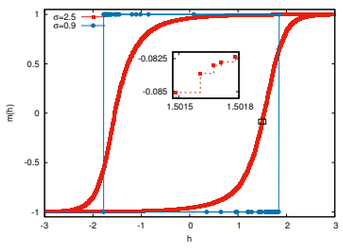


GLAUBER DYNAMICS

Make lower hysteresis loop:
Start from h=-∞

$$s_i(t+1) = sgn[l_i(t)]; l_i = J\sum_j c_j s_j + h_i + h$$

Magnetisation: $m(h,\sigma,c;t) = \frac{1}{N}\sum_i^N c_i s_i$



CRITICALITY

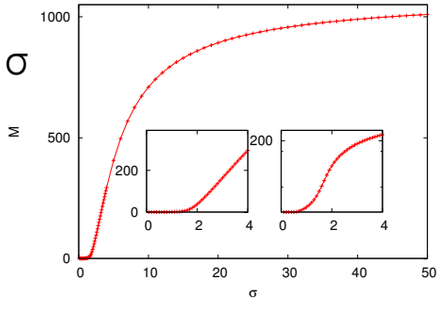
$\sigma < \sigma_c$ (Jumps in m-h curve) $\sigma > \sigma_c$ (Smooth m-h curve)

Check the presence of this critical σ_c

HOW? …METASTABLE STATES COUNT

Total number of metastable states in going from m=-1 to m=1 as a function of σ

Signature of criticality:
Inflexion point

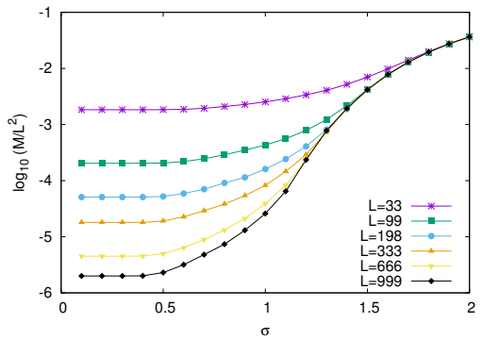


RESULTS:

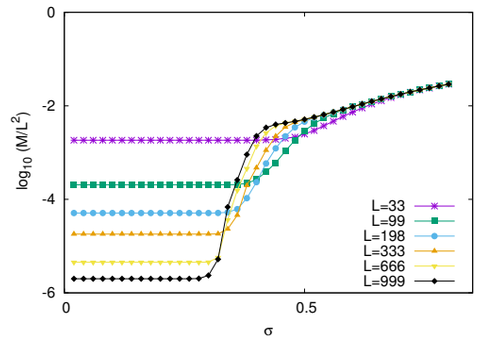
C=1; TRIANGULAR LATTICE (z=6; σ_c PRESENT) [ref.2]

C=0; HONEYCOMB LATTICE (z=3; σ_c ABSENT) [ref.3]

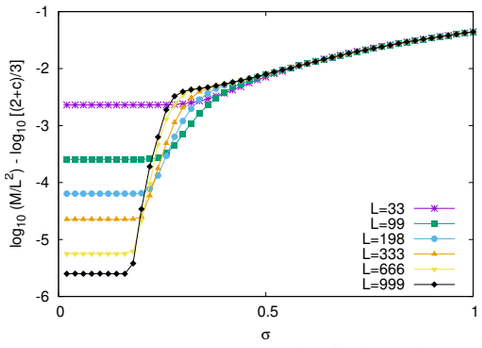
c=1



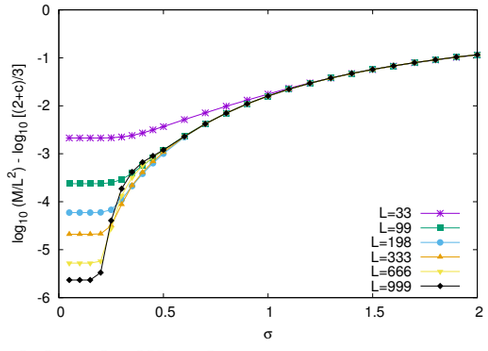
c=0



c=0.4



c=0.6



c ≈ 0.6 is the critical dilution
Need to understand why?
Interplay of random fields and geometric disorder

References:
1. *JP SETHNA ET AL, PRL 70,3347 (1993)*
2. *DT &PS, PRE 88, 042138 (2013)*
3. *S SABHAPANDIT, D DHAR & PS, PRL88 (19), 197202 (2002)*
4. *DT & PS, PRE 99, 062136 (2019)*