

Thu 1 May

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Plan

HW2

Lattice structures, generalizations beyond Ising model

Simple generalizations

Honeycomb $C=3 \rightarrow d+1$

Triangular $C=6 \rightarrow 2(d+1)$

Kagome $C=4$ but not square

Can also generalize Ising model

$$E = -J \sum_{\langle ij \rangle} s_i s_j - H \sum_n s_n$$

$$E_{SG} = - \sum_{j \neq k} J_{j,k} s_j s_k - \sum_n h_n s_n$$

What are ground states for $J > 0$ vs. $J < 0$?

- More spin states $s_i \in \{-1, 1\} \rightarrow \sigma_i \in \{1, 2, 3, \dots, q\}$
- Up/down w/ continuous magnitude $s \rightarrow \phi$, $E \sim -\mu^2 \phi^2 + \lambda \phi^4$
- Fix magnitude, continuous rotations
in 2d $\rightarrow$ XY
or 3d $\rightarrow$ Heisenberg

Fully connected lattice / complete graph

$$E = -\frac{J}{N} \sum_{j \neq k} s_j s_k - H \sum_n s_n = -\frac{J}{2N} \sum_{j \neq k} s_j s_k - H \sum_n s_n$$

low many links?
as function of N

"Curie-Weiss" model exactly solvable

Tricky - make some approximations

Organize $\sum_i \rightarrow$ sum over magnetizations

$$Z = \sum_{m=-1}^1 (\dots) \rightarrow \int_{-1}^1 (\dots) dm$$

for $N \gg 1$

Ferropnictide $\rightarrow$ high $T_c \approx 50$ K

