Magnetization curve of the Shastry-Sutherland model

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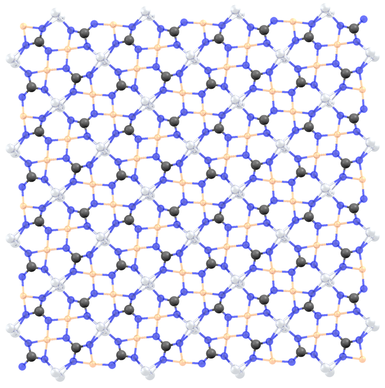
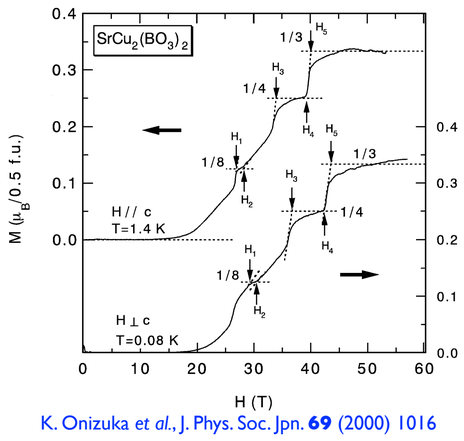
$SrCu_2(BO_3)_2$

structure of a layer



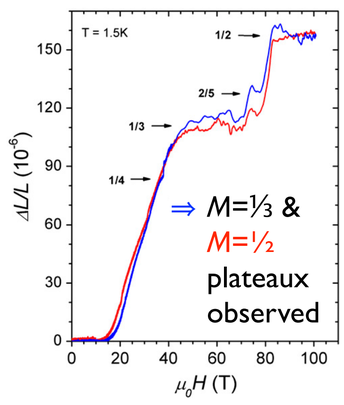
Cu, O, B, Sr

high-field magnetization



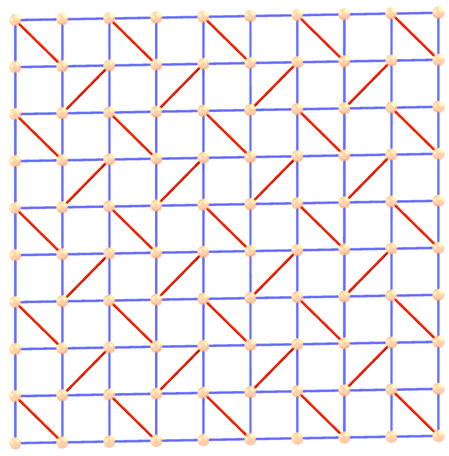
K. Onizuka *et al.*, J. Phys. Soc. Jpn. **69** (2000) 1016

high-field magnetostriction



M. Jaime *et al.*, PNAS **109** (2012) 12404

Shastry-Sutherland model



Hamiltonian:

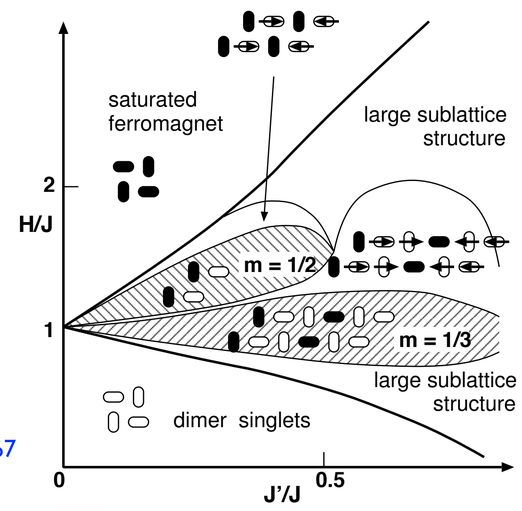
$$\mathcal{H} = \sum_{\langle i,j \rangle} J_{i,j}\, \vec{S}_i \cdot \vec{S}_j - H \sum_i S_i^z$$

exchange constant J for **dimers** and square-lattice coupling J'

$S=½$: almost localized „triplon" excitations

perturbation theory in J'/J:

- ☞ dimer „triplon" particles
- ☞ triplon-triplon repulsions dominate over hopping
- ⇒ crystalline states favored
- ⇒ **plateaux**



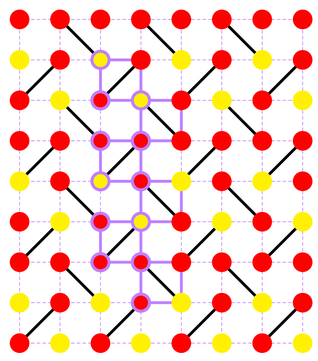
T. Momoi, K. Totsuka, Phys. Rev. B **62** (2000) 15067

$S=\infty$: order-by-disorder stabilization of ↑↑↓-state

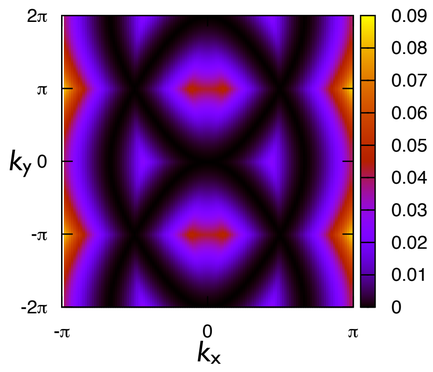
$J'/J = ½$:

- ☞ degeneracy at $M=⅓$
- ☞ ↑↑↓-state: lines of soft modes
- ⇒ stabilization of $M=⅓$ pseudo-„plateau" by fluctuations

classical ↑↑↓-state

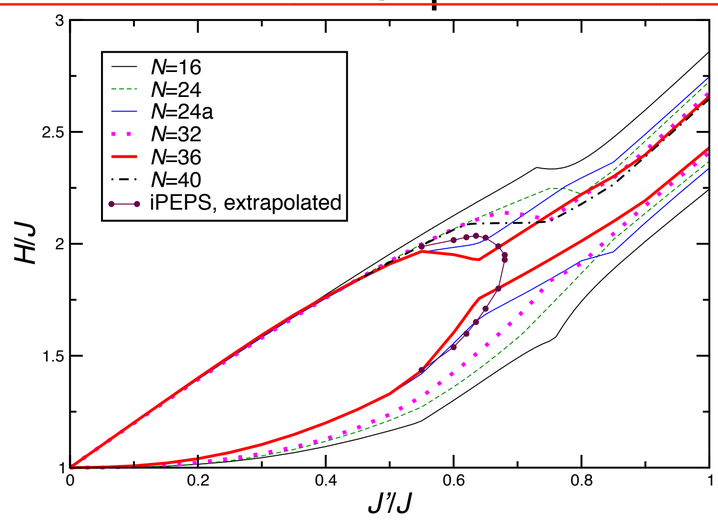


classical spectrum



M. Moliner, D.C. Cabra, A. Honecker, P. Pujol, F. Stauffer, Phys. Rev. B **79** (2009) 144401

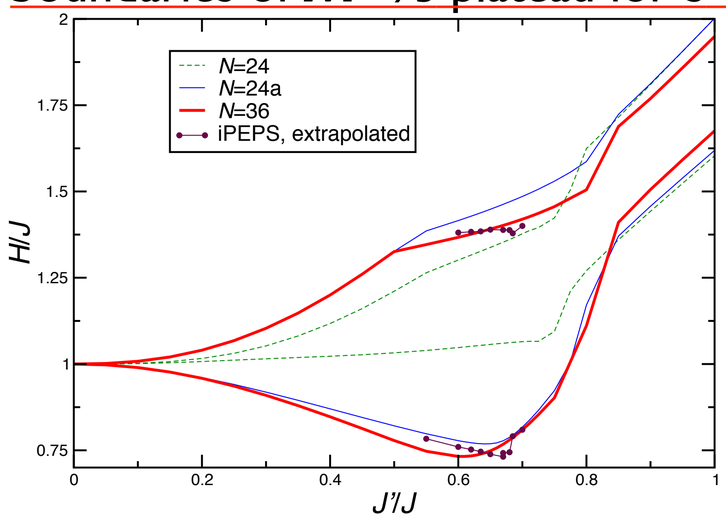
boundaries of $M=½$ plateau for $S=½$



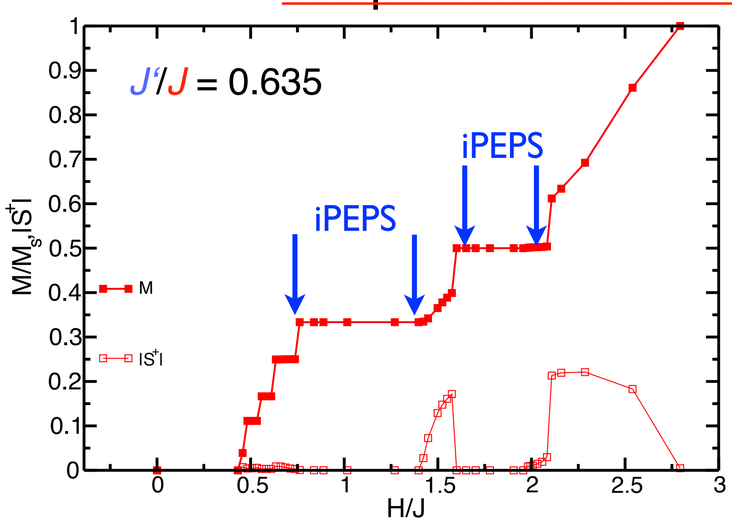
spin $S=½$

- ☞ exact diagonalization for different N
- ☞ iPEPS for $N=\infty$
- ⇒ $M=½$ plateau closes at $J'/J \approx 0.68$
- ⇒ $M=⅓$ plateau persists up to $J'/J \approx 0.8$

boundaries of $M=⅓$ plateau for $S=½$



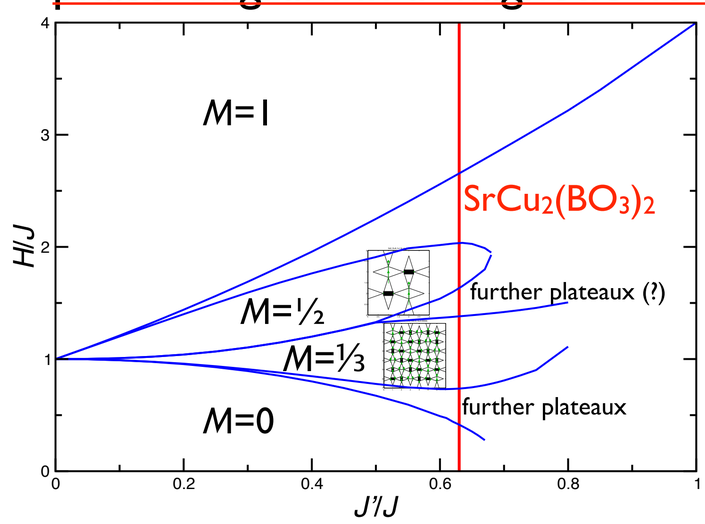
comparison with MERA



Jie Lou *et al.*, arXiv:1212.1999

- ☞ MERA probably overestimates stability of $M=½$ plateau

phase diagram in a magnetic field



acknowledgments

SPINPACK version 2.43 by Jörg Schulenburg

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