Hysteresis and metastability of the antiferromagnetic Heisenberg spin icosahedron

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What happens if people coming from
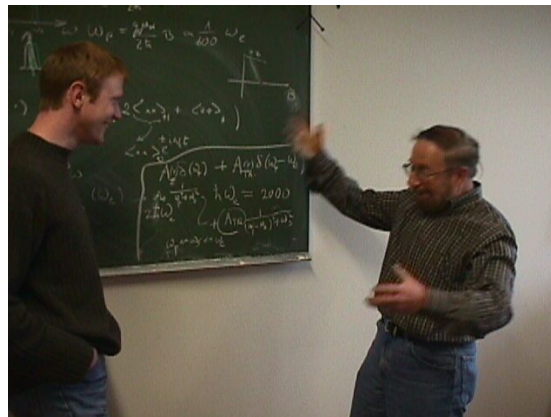

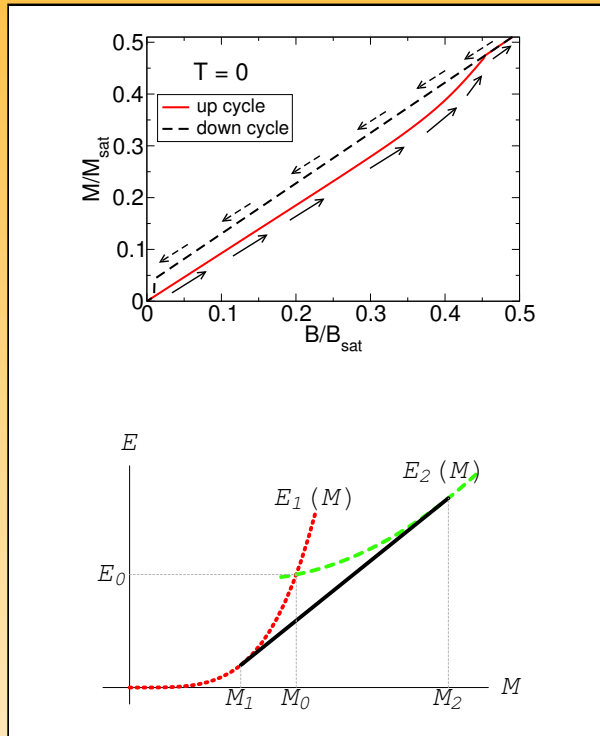transport theory   general relativity   nuclear physics   Zener diodes

are triggered by a "magnetic" enthusiast?

Metamagnetic phase transition I

- Normally hysteretic behavior of SMM is an outcome of magnetic anisotropy.

- The classical AF Heisenberg Icosahedron exhibits a pronounced hysteresis loop.

- It shows a first order phase transition at $T = 0$ as function of B.

- The minimal energies are realized by two families of spin configurations.

- The overall minimal energy curve is not convex $\Rightarrow$ magnetization jump.

C. Schröder, H.-J. Schmidt, J. Schnack, M. Luban, Phys. Rev. Lett., submitted, cond-mat/0501558
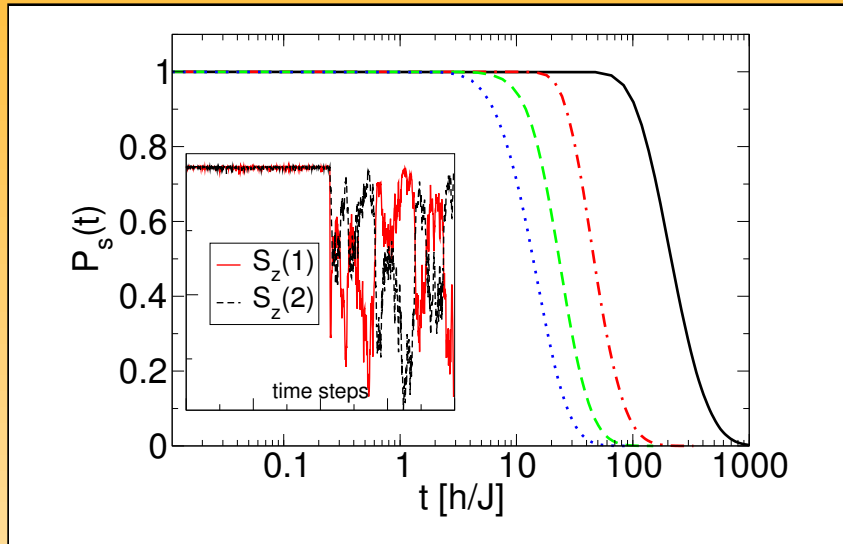
Metamagnetic phase transition II
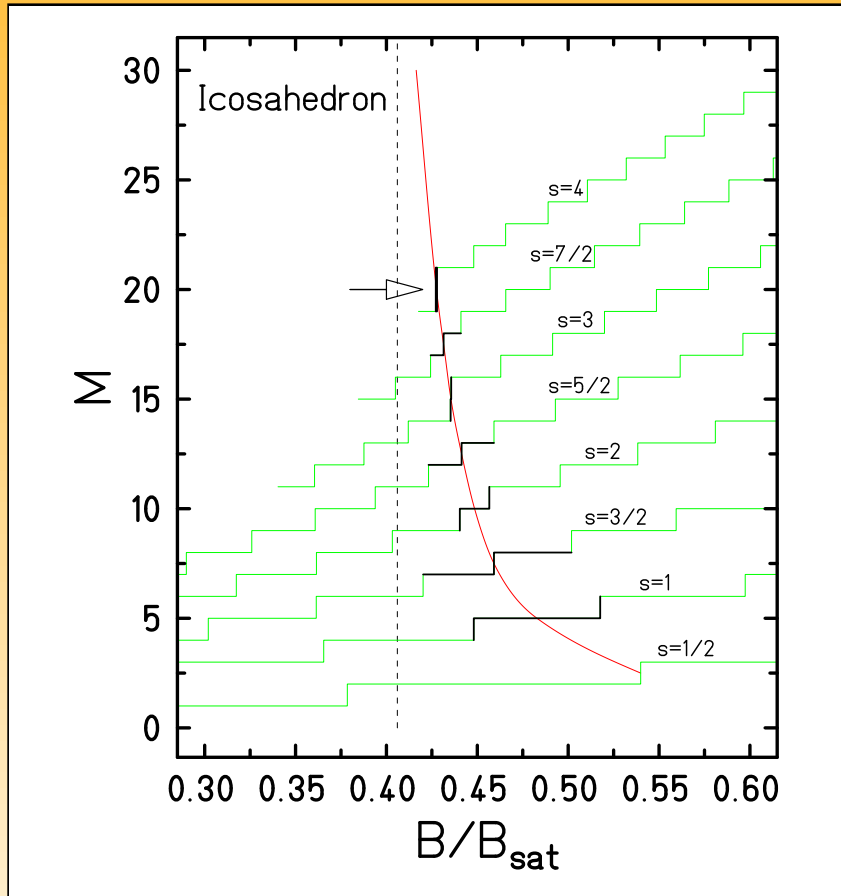
- Quantum analog:
  Non-convex minimal energy levels
  $\Rightarrow$ magnetization jump of $\Delta M > 1$.

- Lanczos diagonalization for various s.

- True jump of $\Delta M = 2$ for $s = 4$.

- Polynomial fit in $1/s$ yields the classically observed transition field.

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Metamagnetic phase transition III

- Finite temperature $\Rightarrow$ finite lifetime distribution.

- Lifetime increases with decreasing T.

- $t_s \to \infty$ for $T \to 0$.

C. Schröder, H.-J. Schmidt, J. Schnack, M. Luban, Phys. Rev. Lett., submitted, cond-mat/0501558

Collaboration

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- J. Richter, J. Schulenburg (Uni Magdeburg);

- S. Blügel (FZ Jülich); A. Honecker (Uni Braunschweig).

- E. Rentschler (Uni Mainz);

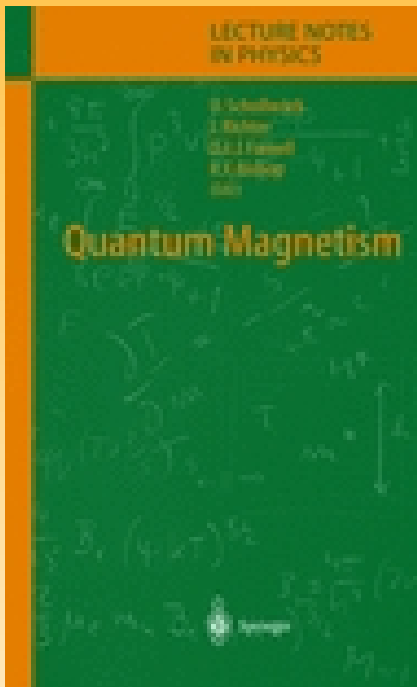# Thank you very much for your attention.

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Quantum Magnetism

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