spin waves and quantum criticality in a frustrated magnet
impossible triangles
AFM Interactions + Square Lattice = Order (No Problem)
AFM Interactions + Square Lattice = Order (No Problem)

AFM + Triangle Lattice = Degeneracy, 3rd law violation?
geometrical frustration

Paramagnet

Short Range Corr.

\[ \chi^{-1} \]

order-by-disorder

lattice distortion

perturbations

spin ice

spin liquid

\[ \Theta_{CW} \rightarrow T_{c} \rightarrow \Theta_{CW} \]

Paramagnet

APS March Meeting

20/03/2009
pyrochlore

$A_2Ti_2O_7$
pyrochlore

$A_2Ti_2O_7$

$A = Ho^{3+}, Dy^{3+}$

Ising Ferromagnet: spin ice
Pyrochlore: $A_2Ti_2O_7$

Ising Ferromagnet: $A = Ho^{3+}, Dy^{3+}$

Spin ice
$A_2Ti_2O_7$

$A = Tb^{3+}$

Ising AFM?

Spin liquid
pyrochlore

$A_2Ti_2O_7$

$A = Er^{3+}$

XY Antiferromagnet: Order-by-Disorder?

rare earth titanates

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Pyrochlore

$A_2Ti_2O_7$

$A = Er^{3+}$

XY Antiferromagnet: Order-by-Disorder?


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Correct ground state, but...
2nd order transition?
No gapless excitations?
Quantum or thermal fluctuations?

erbium titanate
QCP

Applied Magnetic Field (T)

Heat Capacity, C/R

Temperature (K)

- H=0T
- H=1.5T
- H=3T
- H=7T
cf. Transverse Field Ising Model, LiHoF$_4$
50 mK

2 K

erbium titanate

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50 mK

2 K

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erbium titanate

50 mK
50 mK
50 mK, 0 T
50 mK, 0.5 T

(000) (220) (222) (111) (000)
50 mK, 1.0 T

Applied Magnetic Field (T)

T (K)

E (meV)

(000) (220) (222) (111) (000)

20/03/2009
50 mK, 1.5 T

(000) (220) (222) (111) (000)
erbium titanate

50 mK, 2.0 T

(000)  (220)  (222)  (111)  (000)
50 mK, 3.0 T

\(E\) (meV) vs. \(T\) (K) for erbium titanate at 20/03/2009 APS March Meeting.
erbium titanate

complex excitation spectra
continuous qcp? gapless qcp?

\[ \Delta \propto \left| H - H_c \right|^{z \nu} \]
future work:

measure exponents: are they universal?
future work:

other field orientations?