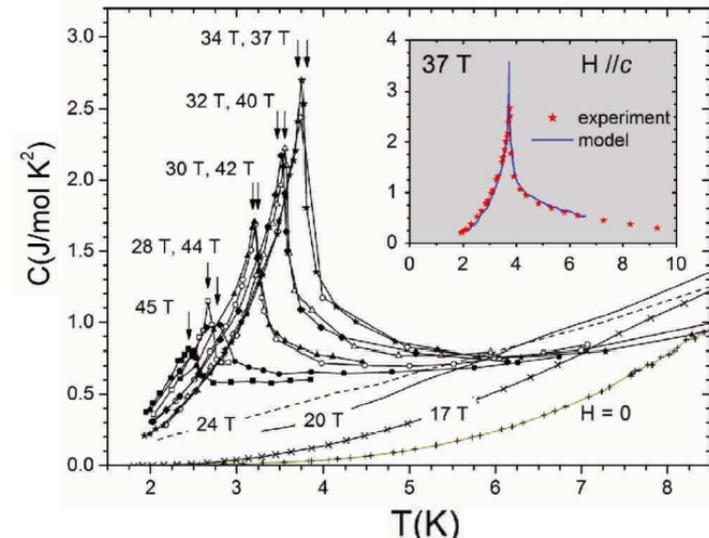
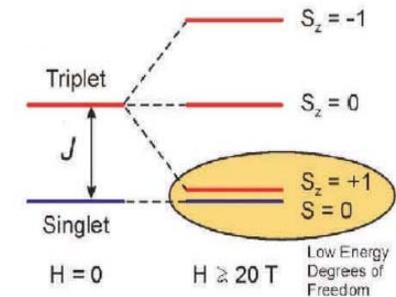


Magnetic-Field-Induced Condensation of Triplons in Han Purple Pigment $\text{BaCuSi}_2\text{O}_6$



A [National High Magnetic Field Laboratory](#) collaboration has recently found evidence of a quantum-mechanical state that is a magnetic analog of Bose-Einstein condensation (2001 Nobel Prize in Physics). This new state is achieved by applying extremely high magnetic fields to a compound containing barium, copper, silicon and oxygen. This same compound was one of the first ever to be artificially synthesized by mankind, invented in China during the Han dynasty and used as a precious purple dye to color its famous terracotta army. High magnetic fields manipulate the magnetic energy levels to a point where the electrons can orient their magnetic spins with equal ease into triplet (aligned spins) or singlet (oppositely aligned spins) states with equal ease. When nature is presented with so many options (called “low-energy degrees of freedom”), it often finds creative ways to correlate electronic motion and magnetism. These correlations can give rise to dramatically new and unexpected behaviors, placing electron correlations and their emergent behaviors as one of the central unsolved mysteries in modern physics.



M. Jaime, et al. Physical Review Letters 93, 087203 (2004)

NHMFL researchers from the Han dynasty (upper left). Magnetic energy levels that intersect at magnetic fields above 20 teslas (upper right). Below are specific heat data at magnetic fields which require the NHMFL’s world-unique 45 tesla hybrid magnet.