dc-Magnetization of $Ba_3Cr_2O_8$

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Introduction

Spin dimer systems with spin singlet ground states have been of considerable recent interest. This interest is in part due to the quantum phenomena associated with excited triplets (magnons), including Bose-Einstein condensation (BEC) and Wigner crystallization. BEC of magnons was first realized in $TlCuCl_3$ and has been subsequently observed in the quasi-1D system $Pb_2V_3O_9$ and the quasi-2D system Cs_2CuCl_4. Wigner crystallization of magnons has been observed in the orthogonal dimmer system $SrCu_2(BO_3)_2$. These discoveries have motivated the search for other spin dimer systems.

Our group has successfully synthesized single crystals of $Ba_3Cr_2O_8$ using the traveling solvent floating zone technique. To our knowledge, we are the first group to successfully grow large single crystals of this system. A manuscript describing the growth and bulk characterization has been submitted to the Journal of Crystal Growth. Typical crystal dimensions are presently 6x4x1mm or 5x3x3mm.

Experimental

We performed torque magnetometry measurements on several different single crystals of $Ba_3Cr_2O_8$ during the fall of 2007. Our results confirmed the single state and allowed us to begin tracing the phase diagram of the Bose-Einstein condensed state. These measurements were performed using the Cell 12 33T resistive magnet with a He^3 cryostat. We used several different torque sensors (all capacitive) with different sample orientations relative to the applied magnetic field.

Results and Discussion

Some of the typical scans of torque as a function of field are shown below for temperatures down to 500mK. We see a sharp increase in the torque at the onset field of about 13T and a saturation above about 22T. From this data we can assemble a rough phase diagram for the Bose Einstein State, shown below. We plan future experiments using a dilution refrigerator to achieve lower temperatures, as well as specific heat measurements to further map the phase diagram.

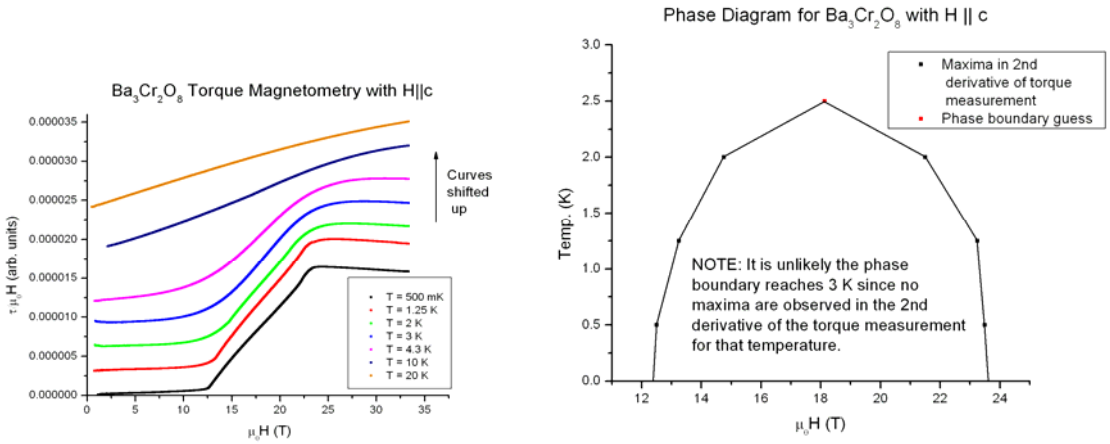

Figure 1. (left) Selected torque measurements for $Ba_3Cr_2O_8$. (right) Proposed BEC phase diagram for $Ba_3Cr_2O_8$.

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