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Title: Pulsed-field magnetization of frustrated  $S = 1/2$   
 $\text{Cu}(\text{pyrimidine})1.5(\text{H}_2\text{O})(\text{BF}_4)_2$

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# NATIONAL HIGH MAGNETIC FIELD LABORATORY

## 2016 ANNUAL RESEARCH REPORT

### Pulsed-field magnetization of frustrated $S = 1/2$ Cu(pyrimidine) $_{1.5}$ (H<sub>2</sub>O)(BF<sub>4</sub>)<sub>2</sub>

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#### Introduction

Cu(pym) $_{1.5}$ (H<sub>2</sub>O)(BF<sub>4</sub>)<sub>2</sub> (pym = pyrimidine) was synthesized and its structure determined by synchrotron single crystal X-ray diffraction.<sup>1</sup> The compound contains  $S = 1/2$  Cu(II) ions arranged in a distorted triangular array (**Fig. 1**). Each Cu(II) ion is coordinated to three pym ligands, two weakly held BF<sub>4</sub><sup>-</sup> anions and one H<sub>2</sub>O. To get a sense to the extent (i.e., strength) of possible frustrated exchange interactions in this new compound we measured the magnetization of Cu(pym) $_{1.5}$ (H<sub>2</sub>O)(BF<sub>4</sub>)<sub>2</sub> in pulsed magnetic fields up to 60 T.

#### Experimental

Magnetization measurements were conducted at the Pulsed-Field Facility of the NFMFL-Los Alamos using a 65 T short-pulse magnet. A powder sample with a mass of ~1 mg was loaded in an ampoule and mounted inside the coil-set of a home-made magnetometer.<sup>2</sup> Data were collected at several temperatures between 0.6 and 20 K.

#### Results and Discussion

**Fig. 2** summarizes our magnetization study. The data acquired at  $T = 0.6$  K show an initial rapid rise in  $M(H)$  which becomes essentially linear above about 35 T and up to the highest field measured. As the temperature increases, the relative rise in the low-field magnetization becomes less pronounced although still persistent. At 20 K,  $M(H)$  is linear for all fields up to 60 T. We speculate that the low-field behavior may be due to fluctuating Cu(II) magnetic moments. At high fields, the linearity appears to be insensitive to the sample temperature suggesting that the strength of magnetic interactions is rather large, consistent with the small magnetization value and lack of saturation at 60 T.

#### Conclusions

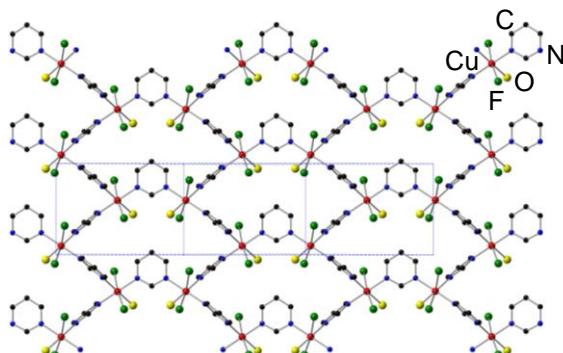
The magnetization behavior of Cu(pym) $_{1.5}$ (H<sub>2</sub>O)(BF<sub>4</sub>)<sub>2</sub> are very interesting and our measurements suggest possible frustrated exchange interactions between  $S = 1/2$  ions. Steps in  $M(H)$  were not observed up to 60 T however, the data presented here were obtained on powder samples. Further experimentation will consist of measurements up to 100 T and possibly torque magnetometry on oriented single crystals.

#### Acknowledgements

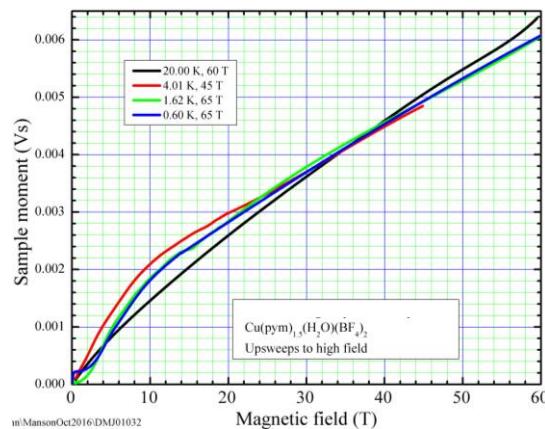
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#### References

- [1] Manson, J. L., et al. manuscript in preparation.
- [2] Goddard, P. A., et al. *New J. Phys.* **10**, 083025 (2008)



**Fig. 1.** Polymeric structure of Cu(pym) $_{1.5}$ (H<sub>2</sub>O)(BF<sub>4</sub>)<sub>2</sub>.



**Fig. 2.** Pulsed-field  $M(H)$  data for Cu(pym) $_{1.5}$ (H<sub>2</sub>O)(BF<sub>4</sub>)<sub>2</sub>.