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Multiple magnetic phases in the frustrated S=1 spin-dimer compound $Ba_3Mn_2O_8$[1]

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$Ba_3Mn_2O_8$ is a spin-dimer compound based on pairs of S=1 $3d^2$ Mn^{5+} ions arranged on a triangular lattice. Antiferromagnetic intradimer exchange leads to a singlet ground state in zero-field. Interactions between dimers broaden the triplet and quintuplet bands such that application of a magnetic field leads to multiple states marked by long range order above characteristic critical fields. Here we present results of magnetization, heat capacity, magnetocaloric effect and torque magnetometry measurements of single crystal samples which reveal a complex phase diagram containing at least three distinct ordered states across the triplet and quintuplet regimes. Much of the phase diagram can be understood in terms of an effective spin ½ Hamiltonian containing only the lowest energy states (|0,0> & |1,1> and |1,1> & |2,2>, referred to the dimer states, for the singlet-triplet and triplet-quintuplet regimes respectively). Two distinct ordered states are observed in the singlet-triplet regime, which can be ascribed to the delicate interplay between single ion anisotropy and antiferromagnetic interdimer exchange on the frustrated triangular lattice.

[1]Worked performed in collaboration with Y.-J. Jo, Y. Kohama, R. D. McDonald, P. Sengupta, M. B. Stone, M. D. Lumsden, G. M. Schmiedeshoff, C. D. Batista, M. Jaime, L. Balicas, and I. R. Fisher