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Magnetic-field-induced quantum phase transition in multiferroic $BiMn_2O_5$ J.W. KIM, S.Y. HAM, Y.S. OH, KEE HOON KIM, Seoul National University, S. PARK, S.-W. CHEONG, Rutgers University, P. SHARMA, M. JAIME, N. HARRISON, NHMFL-LANL — Multiferroic $BiMn_2O_5$ exhibits both antiferromagnetic and ferroelectric ordering below ∼40 K. We have systematically investigated the electric/magnetic phase of $BiMn_2O_5$ by magnetization (M), dielectric constant (ε), electric polarization (P) and specific heat (C_p) measurements down to 0.6 K and magnetic field (H) up to 45 tesla. At 4 K, $BiMn_2O_5$ shows a single magnetic-field-induced transition near H_c ∼18 T as evidenced by a sharp increase in M. Interestingly, ε vs H shows a sharp peak at H_c, of which magnitude systematically increases as critical temperature T_c approaches proximity to 0 K. Furthermore, P changes its sign with increasing H from positive to negative near H_c with no hysteresis. The trajectory of which above three transitions occur follows the scaling relation $T_c(H) \sim (H\text{-}H_c)^{1/2}$. The shape of C_p vs H curve indicates that this transition is 2^{nd} order down to 0.6 K, consistent with the absence of hysteresis in M, ε, and P measurements. Temperature dependent ε measurements under fixed H near H_c reveal that ε increases on cooling to 5 K and slightly decreases down to 0.6 K, as similarly observed in a quantum paraelectric $SrTiO_3$. All of these observations support an interesting possibility that $BiMn_2O_5$ can be the first system to exhibit quantum fluctuation of ferroelectricity tuned by magnetic field.

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