Electric polarization reversal under high magnetic field in square lattice antiferromagnet $\text{Ba}_2\text{CoGe}_2\text{O}_7$ JAE WOOK KIM, S.H. CHUN, S.H. KIM, KEE HOON KIM, Seoul National University, Y. JO, L. BALICAS, NHMFL, Y.J. CHOI, S.-W. CHEONG, Rutgers University, F. BALAKIREV, N. HARRISON, LANL — Recently, $\text{Ba}_2\text{CoGe}_2\text{O}_7$ was found to develop electric polarization ($P$) below $T_N=6.7\text{ K}$ [1]. Interestingly, $P$ along the $a$-axis increases linearly, crossing zero at $H=0$ when magnetic field ($H$) is applied along the $c$-axis. To investigate the linear $H$-dependence of $P$ further, we measured $P$ dielectric constant ($\varepsilon$), and magnetization ($M$) under high $H$ up to 45 T. On application of high $H$, $P$ increases linearly up to $H\sim 15\text{ T}$ but suddenly decreases to a constant negative value. A peak in $\varepsilon$ is found at the $P$-reversal point which is suppressed with increasing $H$ to lower temperature with a concomitant sharpening up to $H\sim 36\text{ T}$ at $T=0.6\text{ K}$ Furthermore, $M(H)$ curves below $T_N$ show saturation above the $P$-reversal magnetic field, indicating that the negative $P$ state is due to the fully ordered spin configuration. This phenomenon is similar to the case of multiferroic $\text{BiMn}_2\text{O}_5$, in which $P$ reversal is driven by a spin-flop crossover [2]. However, in $\text{Ba}_2\text{CoGe}_2\text{O}_7$, $P$-reversal does not accompany a $H$ induced magnetic phase transition. We discuss possible mechanisms for this unique magnetoelectric behavior and suggest possible quantum phase transition behavior. [1] H. Yi et al., Appl. Phys. Lett. 91, 212904 (2008). [2] Jae Wook Kim et al., arXiv:0810.1907.

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