Magnetic phase transition induced by an electric field

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Significant technological progress has been made recently in the electrical field control of magnetism, in particular electrical switching or reversal of magnetization or even tuning between phases. On the other hand theoretical papers have been mainly focused on the one-dimensional systems. In the present paper we have studied the influence of the interchain coupling, magnetic field, and next-nearest-neighbor interaction in the coupled XY spin chains model with the next-nearest-neighbor, Dzyaloshinskii-Moriya $(S_n^x S_{n+1}^y - S_n^y S_{n+1}^x)$, and magnetoelectric $(S_n^x S_{n+1}^y - S_n^y S_{n+1}^x) S_{n+2}^z$ interactions on the shape of the magnetization as a function of the electric field at finite temperature. Using the linear perturbation renormalization group recursion relations the phase diagram in the plane (temperature, electric field) is found. The phase transitions to two different low temperature phases and a reentrance behavior caused by the electric field are observed. At finite temperature for some range of the interchain interaction values in addition to changing the magnetization sign with reversal of the electric field, there is a possibility to the magnetization sign switch in finite electric field values with no applied magnetic field.