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Field-Effect Birefringent Spin Lens in Ultrathin Film of Magnetically Doped Topological Insulators PEIZHE TANG, Department of Physics, State Key Laboratory of Low-Dimensional Quantum Physics, Tsinghua University, LU ZHAO, Department of Physics, State Key Laboratory of Low-Dimensional Quantum Physics, Tsinghua University; School of Physics, Beihang University, BING-LIN GU, Institute for Advanced Study, Tsinghua University, WENHUI DUAN, Department of Physics, State Key Laboratory of Low-Dimensional Quantum Physics, Tsinghua University — We investigate the low-energy electron dynamics in two-dimensional ultrathin film of magnetically doped topological insulators in the context of gate-tuned coherent spin manipulation. Our first-principles calculations for such film unambiguously identify its spin-resolved topological band structure arising from spin-orbit coupling and time-reversal symmetry breaking. Exploiting this characteristic, we predict a negative birefraction for chiral electron tunneling through a gate-controlled p-n interface in the film, analogous to optical birefringence. By fine-tuning the gate voltage, a series of unusual phenomena, including electron double focusing, spatial modulation of spin polarizations, and quantum-interferenceinduced beating patterns, could be efficiently implemented, offering a powerful platform to establish spin-resolved electron optics by all-electrical means. L. Z. and P. T. contributed equally to this work. We acknowledge support from the National Natural Science Foundation of China (Grants No. 11204154 and No. 11074139) and the Ministry of Science and Technology of China (Grants No. 2011CB606405 and No. 2011CB921901).

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