Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Quantum Spin Hall Effect in Two-Dimensional Transition Metal Dichalcogenides[1] XIAOFENG QIAN, Texas A&M Univ, JUNWEI LIU, LIANG FU, JU LI, Massachusetts Institute of Technology — Quantum spin Hall (QSH) effect materials have an insulating bulk but conducting edge states that are topologically protected from backscattering by time reversal symmetry. However, the small band gap and the lack of efficient on/off switching in materials that have been identified as QSH insulators limit their applications. Here using first-principles calculations we predict a class of large-gap QSH insulators in two-dimensional transition metal dichalcogenides with 1T' structure, namely, 1T'-MX_2 with M=(W, Mo) and X=(Te, Se, S)[2]. A structural distortion causes an intrinsic band inversion between chalcogenide-*p* and metal-*d* bands. Additionally, spin-orbit coupling opens a gap that is tunable by vertical electric field and strain. We propose a topological field effect transistor made of van der Waals heterostructures of 1T'-MX_2 and 2D dielectric layers that can be rapidly switched off by electric field through topological phase transition instead of carrier depletion.

[1]We acknowledge support from NSF under Award DMR-1120901 and DMR-1231319, DOE Office of Basic Energy Sciences under Award DE-SC0010526, and XSEDE under the grant number TG-DMR130038 and TG-DMR140003.
[2]Xiaofeng Qian, Junwei Liu, Liang Fu, and Ju Li, arXiv:1406.2749 (2014)

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Date submitted: 09 Nov 2014 Electronic form version 1.4