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Symbiosis of ferromagnetism and superconductivity in topological insulators[1] Y. S. HOR, Y. QIU, K. N. SANDERS, J. E. MEDVEDEVA, T. VOJTA, Missouri University of Science and Technology, J. DAI, W. WU, Rutgers University, P. GHAEMI, City College of the City University New york — Three-dimensional topological insulators (TIs) have been found to depict topological distinct phases of matter and have attracted great interest due to helical spin texture on the surfaces. By Nb-doping in bismuth selenide, the TI turns into a type-II bulk superconductor while maintaining its helical metallic surface state in its normal state. However, at high magnetic field this doped TI behaves superparamagnetically. Niobium is usually considered a non-magnetic cation but it exhibits a unique magnetic behavior in this doped TI. Moreover magnetic correlations appear in the system when the superconductivity emerges at below 3.2 K, presenting novel magnetic coupling of the Nb cations through modification of supercurrents mediated by Nb magnetic moments. As a consequence, ferromagnetism is induced in the superconducting regime below the upper critical field. Magnetic susceptibility of the TI shows paramagnetic behavior at high field due to destruction of the superconductivity which is the underlying bases for ferromagnetic coupling of Nb moments. The superconductivity and ferromagnetism, which are usually mutually destructive, can mutually benefit each other in the system giving rise to a zero-field magnetization which results in a symbiotic relationship between ferromagnetism and superconductivity.

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