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Gapless Andreev bound states in a topological junction on the Quantum Spin Hall insulator HgTe

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Two dimensional topological insulators coupled to superconducting and ferromagnetic electrodes are a candidate system for the realization of Majorana fermions. Majorana physics has recently attracted considerable attention in both theoretical and experimental studies due to the prospects for new physics stemming from non-Abelian exchange statistics and the associated applications to topological quantum computation. However, experimental studies unveiling the interplay between superconductivity and topological electronic transport remain scarce. Here we report the observations of signatures of topological superconductivity induced in a HgTe quantum well, a system that exhibits the quantum spin Hall effect. Namely, we observe the fractional Josephson effect, in two different manners. When an rf excitation is applied, a doubling of the Shapiro steps is observed [1]. Besides, a clear emission line can be detected at half the Josephson frequency under dc voltage bias conditions [2]. Both features appear more clearly when the sample is gated towards the quantum spin Hall regime, in a regime where the current flows mostly along the edges of the device. These signatures thus strongly point towards induced topological superconductivity in the quantum spin Hall edge states. [1] E. Bocquillon et al., Nature Nanotechnology 10.1038/nnano.2016.159 [2] R.S. Deacon et al., arXiv 1603.09611