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Experimental studies on hybrid superconductor-topological insulator nanoribbon Josephson devices MORTEZA KAYYALHA, Purdue University, LUIS JAUREGUI, Harvard University, ALEKSANDER KAZAKOV, IRENEUSZ MIOTKOWSKI, LEONID ROKHINSON, YONG CHEN, Purdue University — The spin-helical topological surface states (TSS) of topological insulators in proximity with an s-wave superconductor are predicted to demonstrate signatures of topological superconductivity and host Majorana fermions. Here, we report on the observation of gate-tunable proximity-induced superconductivity in an intrinsic $BiSbTeSe_2$ topological insulator nanoribbon (TINR) based Josephson junction (JJ) with Nb contacts. We observe a gate-tunable critical current (I_C) with an anomalous behavior in the temperature (T) dependence of I_C. We discuss various possible scenarios that could be relevant to this anomalous behavior, such as (i) the different temperature dependence of supercurrent generated by in-gap, where phase slip plays an important role, and out-of-gap Andreev bound states or (ii) the different critical temperatures associated with the top and bottom topological surface states. Our modeling of I_C vs. T suggests the possible existence of one pair of in-gap Andreev bound states in our TINR. We have also studied the effects of magnetic fields on the critical current in our TINR Josephson junctions.

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