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Antisymmetric of Conductance in Bias Splitting

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ABSTRACT

Conductance asymmetry was studied using continuous change in the bias splitting. Zero bias conductance was obtained. Determination of excitations in magnetic topological insulator provided control parameter i.e. bias split. Conductance signals were created by trivial Andreev levels magnetic topological insulator, which were centrally proximitized. It was found that in presence of non-trivial state the conductance was found antisymmetric. It was presented that interface varied with bias splitting. It was found that when potential was applied the creation of super conductance was obtained. Total conductance was obtained. Total conductance was antisymmetric around completely unbalanced bias splitting.

KEYWORDS Conductance, Excitation, Topology, Asymmetric, Antisymmetric.

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INTRODUCTION

Wang et al. presented topological surface states for creation of robust platforms for quantum computation in proximity coupling for propagation of modes [1]. Zhang et al. used proximitized magnetic topological insulators for experimental detection of different modes. Characteristic features of Majorana states were presented. Simulations were utilized for Majorana states, which leaded transport in normal superconductance, normal and proximitized magnetic topological insulators, considering splitting symmetry with respect to central lead [2]. Zhang et al., Parda et al. and Sauls studied that without trivial Andreev bound states, non topological one dimensional bound state were found [3,4,5]. Pan et al. [6] and Anselmetti et al. studied transport behavior on two interfaces of junction for detection of bound states on ends of proximitized semiconducting wires, using multiterminal transport measurements and noise calculations [7]. Maiani et al., Danon et al. and Menard et al. studied conductance matrix symmetries of particle hole for fabrication [8,9,10]. Chung et al. studied chiral states acted as uninterruptedly by normal and proximitized leads and edge currents, which were transmitted. It was found that quantum anomalous Hall regions were separated in two Majorana chiral propagating states at interfaces of the junction which were transmitted and other was totally reflected [11]. Lambert et al. studied electric conductance in topological normal superconductor-normal junctions using Blonder-Tinkham-Klapwijk formalism [12]. Setiawan et al. studied that interfaces between normal and superconducting magnetic topological insulators for reproduction [13]. Osca et al. studied that oscillations around plateaus were found. Total bias across junction was found lower than bulk energy gap [14]. Benchtaber et al. studied that transport in nontranslation-invariant system, normal superconductor normal junction was explained considering complex band structure approach. This was a double junction modeling due to solution of matrix version [15].

METHOD

Antisymmetric conductance was obtained by analyzing electric transport by normal junction having magnetic topological insulators consisting of central proximitized sample. Electric current in normal terminals of doukle junction is written as

$$I_i = \int_0^\infty dE \sum_a s_a \left[J_i^d(E) - K_i^a(E) \right]$$

Where I_i is current in normal terminals, $i = 1, 2, 3, , a \in \{e, h\}$ is electron and hole degrees of freedom, $s_{e,h} = \pm 1$.

$$J_i^a(E) = \frac{e}{h} N_i^a(E) f_i^a(E).$$

$$K_i^a(E) = \frac{e}{h} \sum_{ib} p_{ij}^{ab}(E) f_i^b(E)$$

are coming and outgoing fluxes of quasi particles, f_i^a is the Fermi distribution function, p_{ij}^{ab} is the transmission probabilities of quasiparticle of type *a* in lead *i*. Differential conductance is in normal terminals of double junction is given by $G_i = \frac{\partial I_i}{\partial V}$, where $V = V_1 - V_2$ is total bias across the junction, V_i is the voltage difference between *i*th lead and central region. Different transport processes in junction depended on topological phase of proximitized region. Scattering amplitudes were obtained. Quantum anomalous Hall states were coupled. Electrical conductance was found, vanished in low bias limit then scattering processes were found dominant due to normal reflection. Antisymmetric relation to total conductance is expressed in conductance matrix and current voltage realtion is given by

$$\begin{pmatrix} I_1 \\ I_2 \end{pmatrix} = \begin{pmatrix} g_{11} & g_{12} \\ g_{21} & g_{22} \end{pmatrix} \begin{pmatrix} V_1 \\ V_2 \end{pmatrix}$$

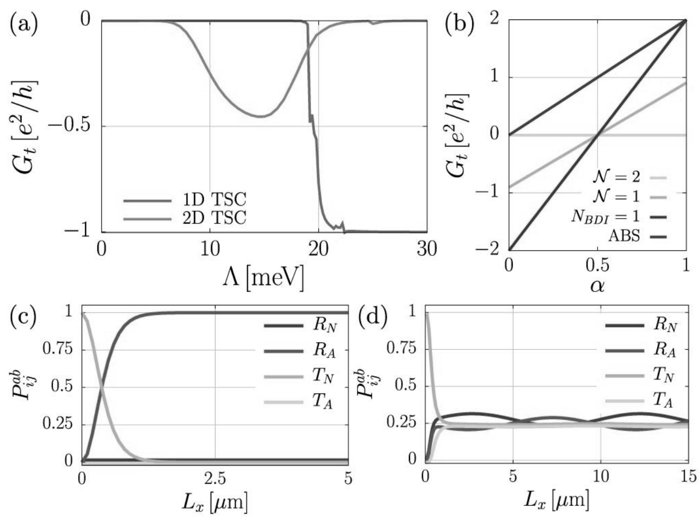
using two terminal transport between the leads of three terminal device, the process of Andreev was formulated at proximitized part. Antisymmetric condition is given by the relation

$$(g_{11} - g_{12}) = (g_{22} - g_{21})$$

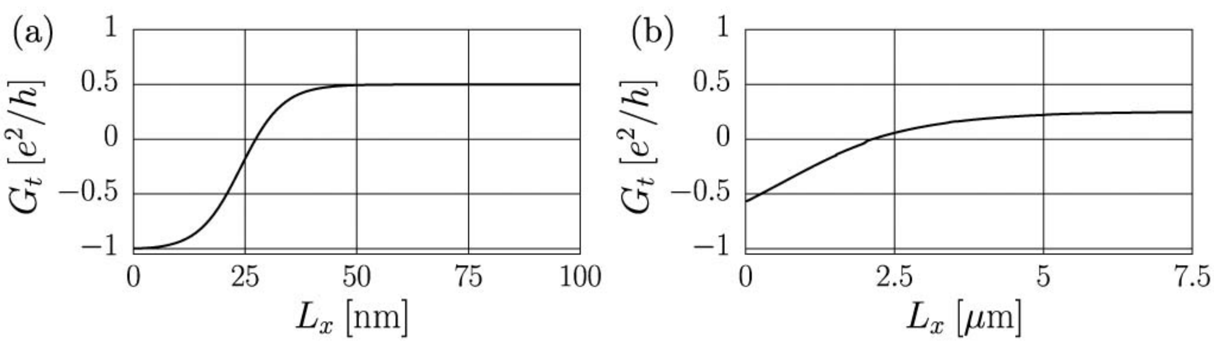
The difference between local and non local conductances were found same for both terminals.

RESULTS AND DISCUSSION

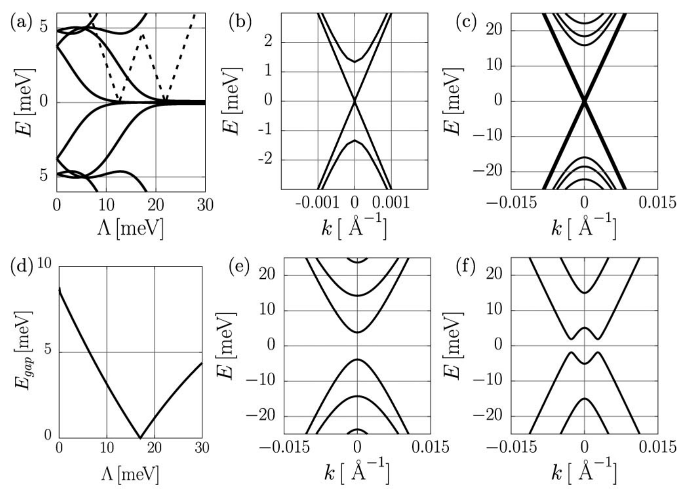
Charge nonconserving Andreev processes were used for nonzero conductance associated with electric current to normal junction topological, saved modes were needed for antisymmetry conductance in respect of equality split bias. Graph (1) shows the plot of conductance versus magnetization of magnetic topological insulators for asymmetric bias. Graph (1)(b) shows plot of conductance as function of split parameter for nontrivial phases. Oscillations were also found around plateau between back-scattered chiral modes from two interfaces of double junction. Total bias across junction was found lower than bulk energy gap. Graph (2) show the plot of total conductance as a function of length of barrier. Graph (2)(a) and (2)(b) present geometry of wire with proximitized part in the central section. It was found that the length of intermediate barrier was dependent on geometry of wire. Transparent barrier of the conductance was found due to magnetic topological bound states. When opaque barrier was increased then conductances were changed due to magnetic topological bound states along Andreev processes were found in proximitized magnetic topological insulator. Long barrier prevented electric transmission on right sight leaded to conductance. Graph(2) also showed the set of parameters antisymmetry robust for barriers for magnetic bound states were unaffected by barrier. Graph (3)(a) shows low energy eigen values. Graph (3)(b) and (3)(c) showed band structure of different phases. Graph (3)(b) also presented a chiral propagating states and characterized chiral topological case corresponded to quasi particle spectrum of proximitized system. Graph (3)(e) and 3(f) show full band structures of two distinct phases. Graph (3)(f) also indicated normal order of energy bands of nontrivial topology of bulk and bulk boundary correspondence at ends of wires having finite length. It was found that during Andreev processes a non-zero conductance was found. Antisymmetry of conductance also occurred.



Graph 1: Plot of conductance in normal junction as function of magnetization and bias split.



Graph 2: Plot of total conductance.



Graph 3: Plot of low energy as function of Zeeman field.

CONCLUSION

Study of antisymmetry conductance with respect to split bias voltage across the junction was made. Normal junction was made of narrow magnetic topological insulator sample, which was centrally proximitized. Conductance of magnetic topological insulators were found antisymmetric in response to splitting of bias, which was reflected. Conductance asymmetry having continuous change in bias splitting was very selective than zero-bias conductance.

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