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Peer-reviewed version available at Symmetry 2020, 12, 774; doi:10.3390/sym12050774

Chern-Simons Current of Left and Right Chiral Superspace in Graphene Wormhole

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We specify basic definitions of the Chern-Simons current in cohomology theory, then we calculate its value by using a model of quantum machine learning, the so-called supersymmetric support Dirac machine. The supercurrent is generated from the coupling between three states of a quantum flux of modified Wilson loop of the Cooper pairs. We use Holo-Hilbert spectrum in frequency modulation to visualize the network as a coupling behavior of convolutional neuron network in superstatistical theory with the application to the theory of a superconductor. We also calculate the number of carbon atoms in the stable support spinor network structure of a graphene wormhole to produce a supercurrent of Cooper pairs as graviphoton states by using the Holo-Hilbert spectral analysis.

Keywords: graphene, Chern-Simons current, Holo-Hilbert spectral analysis, cohomology

I. INTRODUCTION

A Chern-Simons current [1, 2] of quantum flux attached to the Cooper pairs [3] and a graphene wormhole are two interaction theories with possible useful application in superconductivity [4–6]. We can consider a new theory as a meeting point of superstatistics and superspace theory [7] incorporated in a predictive model. In recent years, quantum machine learning [8] with the intrinsic behavior of a supersymmetric Dirac neural network [9] and a support spinor machine [10] have been actively searched. These new models have their roots in older Wilson loops of gauge theory [11], in cohomology of time series data [12], in the support spinor network and in the geometrical description of gravitational theories [13–15].

The geometry of a graphene structure can be realized as a carbon lattice with six carbons per one lattice link with three bonds and free electrons. From the point of view of chemical properties, it is not an organic material because of the lack of hydrogen atoms that are replaced by Cooper pairs of two electrons. The supercurrent can be generated from the topology of graphene in a wormhole structure with optimized number of carbon atoms and holonomy of a connection of the Cooper pairs in spinor network. The graphene wormhole is considered as the dual geometry of the C_{60} fullerenes, the spherical geometry of graphene with superconductivity states. With urgent demand in high speed supercomputer made from the Josephson junction and new type of artificial intelligent quantum machine learning, the graphene wormhole supposes to be one of the candidates for synthesized material to build a new quantum computer with deep learning behavior [16].

In nonrelativistic quantum mechanics, a wavefunction is the most important mathematical object for the basis in the Hilbert vector space of free electrons in graphene carbon atoms, to find the classical probability for an electron as a square of the Hilbert norm. On the other side quantum field theory use scalar, vector, tensor and spinor fields as basic objects to study Yang-Mills fields and gravitational field induced from electronic property of electron spin. It is challenging to replace general explicit Fourier basic form of Fourier transform of first Brillouin zone with empirical mode decomposition [17] (EMD) with adaptive basis of Hilbert transform with instantaneous frequency as a spectra of momentum for the Cooper pairs, the so called Holo-Hilbert spectra [18] of hidden higher dimensional layers of Kolmogorov space in nonlinear and nonstationary time series, in simulation data of the spectra for free energy in the graphene.

The Chern-Simons theory plays an important role to unify quantum mechanics wave function with gauge field in the form of Wilson loop in the forming of supersymmetry anomaly of the Cooper pairs, the so called Chern-Simons supercurrent for the Cooper pairs. Scientists and engineers are interested in the application of the Chern-Simons supercurrent mainly through the superconductor theory in graphene wormhole. The quantum tunneling of the Cooper pairs in the graphene wormhole from the left to right supersymmetry is explained by using quantum foam

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over supersymmetric support Dirac network (SSDM). The edge of network is a holonomy of connection as modified Wilson loop with quantum phase transition to superconductor state in the form of quantum machine learning over SSDM. The Cooper pairs coupling with the graviphoton plays a very important role to explain the Chern-Simons current in superconductor. We use the Cooper pair as a small quantum machine learning unit of adaptive property between two electronic coupling energies as support Dirac network for learning the order parameter in the superspace of graphene wormhole. We use a new empirical analysis of Holo-Hilbert spectral approach with predefined new model to compute the Chern-Simons supercurrent in the graphene wormhole with size and width of the wormhole as predictive parameters. In this model, the computation of Josephson current [19] by using the Chern-Simons current is performed by using the conservation law of free energy with constant curvature change with respect to the change of connection between free electrons in the Cooper pair and their curvature in the supercurrent inside the graphene wormhole as the graviphoton.

This approach can be applied to other theoretical models of time warping of spinor network [20] of machine learning [21] as forecasting methods by using a prediction of parameters in states of superconductivity [22]. A mathematical and physical properties of wormhole might be suitable for testing the existence of a graviphoton as hidden fifth force in extradimension of quantum foam inside a graphene wormhole structure. The realtime dynamics of chiral magnetic effect in the superconductivity of graphene wormhole is under active research in many scientific communities with many applications to superconductors. The Chern-Simons current of Wilson loop as single chiral magnetic charge inducing coherent electric current and graviton is interested to be found as the exchange gauge field of chiral symmetry breaking between two pairs of a photon and a graviton and free electron pair, so called graviphoton [24]. For quantum tunneling in a wormhole, the Cooper pairs tunnel from superconductor can warp though normal Josephson junction and break a supersymmetry with Cooper pairs chiral anormaly in fifth dimension [25] as extradimension model of graphene wormhole produce graviphoton [26] like tachyonic particle [27] in quantum entaglement state. The situation is analogue to qubit states of quantum computer which can be produced from graphene wormhole as Josephson junction. At relativistic scale of macroscopic world, physicists noticed that the universe is dominated by left hand alpha decay of quarks [28]. The graphene wormhole is supposed to be the scale at which the Josephson effect in superconductor [29], like the dark energy scale in cosmology [30], can be simulated as a new types of superconductivity. In other words, it is a tunable superconducting quantum interference device [32] for quantum supercomputer made from graphene [33].

The role of supersymmetry [34] is actively searched in chiral symmetry breaking graphene superconductor condition [35] of free electron transport through the graphene wormhole [36]. The graphene wormhole connects two graphene sheets [37] as D-brane and anti-D-brane [38] of superconductor with the Chern-Simons supercurrent in D-brane model. In this situation, we can realize the Chern-Simons manifold as an Einstein-Rosen bridge between the child manifolds of the graphene. This model can be considered as supersymmetry breaking model for quantum foam of Calabi-Yau manifold in the graphene wormhole.

This paper is organized as follows. In Section II we specify the basic definitions of the Chern-Simons current and the graviphoton in cohomology theory. In Section III we calculate the Chern-Simons current by using SSDM over quantum foam model. We use ribbon graph over support spinor network with predefined connection of the Cooper pairs attached to the edge. We implement the algorithm over Holo-Hilbert spectral frequency modulation and SSDM algorithm of quantum machine learning for finding the prediction of order parameters for superconductivity state. In Section IV we discuss the results of computation of the Chern-Simons current for superconductor in graphene wormhole and then we draw conclusions.

II. CHERN-SIMONS CURRENT FOR SUPERCONDUCTOR

A. Modified Wilson loop for behavior of Coopers pairs

In quantum mechanics the orbital of electron in a graphene is modelling as a wavefunction $\Psi(k) = \sum_k c_k \mathrm{e}^{-\mathrm{i}kx}$ with the probability to find in momentum space k and $-k$ in sphere of Fermi sea. In Ginzburg-Landau (GL) theory we use $|\Psi(k)|^4$ in 4 spheres S^4 for a superstatistics of coupling in the Chern-Simons 3-forms between the Cooper pairs and a graviphoton. The wavefunction separates into the left and right supersymmetry in upper half plane of complex plane. The left symmetry of orbital is modeled by Hilbert transform $\Psi(k) = \mathrm{Re}\sum_k^N c_k \mathrm{e}^{-\mathrm{i}\omega(t)}$ with three hidden layers of instantaneous frequency. The right supersymmetry is an imaginary part and it is hidden.

Let X_t/Y_t be a superspace of the Chern-Simons (CS) manifold D-brane of graphene wormwhole. The cohomology theory of superspace uses for measuring the invariant property of equilibrium state of coupling between Cooper pairs and graviphoton. The role of Bose-Einstein condensation as the equilibrium of electron vibration in the lattice of graphene induces a superstatistic with a superdistribution of cocycle of wavefunction of Cooper pairs in $\mathrm{Tr}H^3(X_t/Y_t)$ where $[\beta_t(|\Psi(x)|^4)]$ is an equivalent homotopy path of cocycle in equivalent value of an order parameter for a superconductor. In GL theory of phase transition, the order parameter to change normal state to superconductivity state

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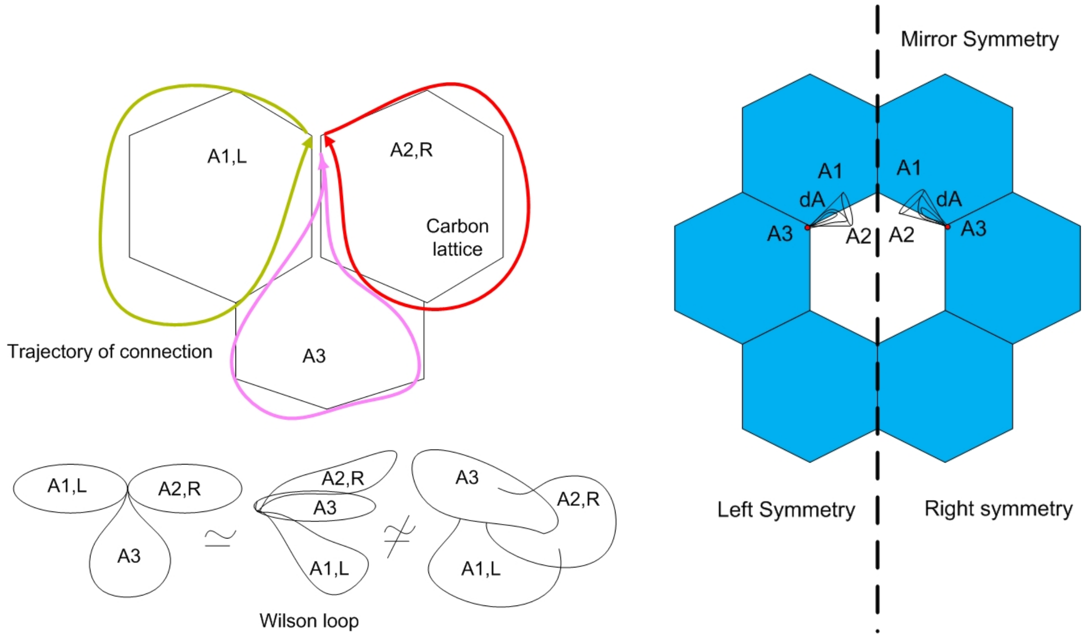

Figure 1. The visualization of the modified Wilson loop of connection over graphene lattice of six carbon atoms (left) and the visualization of free electron over supersymmety structure of graphene hexagonal atoms (right). The electron starts to move freely at A_3 connection with modified Wilson loop localized around carbon backbone bonding in the cone as dA_1 connection over A_2 connection over other carbon ring atoms. The group operator of symmetry breaking between left and right mirror symmetry repeats the pattern of moving free electrons as chiral symmetry breaking gauge group action over connection of spinor field of Cooper pairs along topological space of invariant property of molecular orbital of sp^2 in graphene carbon atoms.

is a condensed wave function of the Cooper pairs. The fourth order of wave function is analogy with a new type of the Chern-Simons current with $J^{\mu=\beta} := \int_{\mathrm{Tr}H^3(X_t/Y_t)} A \wedge A \wedge A$. It might be also new type of superstatistics of Bose-Einstein condensation in supercurrent condensation state in fourth dimension induced by the integration of 3-forms over three attributes of new type of modifield Wilson loop as coupling behavior of the Cooper pairs $A_\mu \wedge A_\mu \wedge A_\mu$ (see Fig. 1). By the interaction of two mathematical hybrid objects, so called Wilson loop A_μ and the Chern-Simons current J^μ, we can relax gauge theory definition and redefine new mathematical objects for more flexible and suitable study of phase transition in the superconductor.

The quantum foam model in graphene wormhole is a moduli state space model similar to quantum dots, an array of Josephson junction. Inside the Josephson junction there exists a supercurrent tunneling effect across the wormhole from the left supersymmetry to right supersymmetry. The model of Cooper pairs tunneling across Josephson junctions involves three forms of coupling between three Lie algebras. The first form is induced from the coherent state of coupling between a photon with a graviton. The second and third fields are the Cooper pairs of electrons in graphene wormhole with quantum foam condensation states. The superconductivity state of Coopers pairs is related to ribbon graph of loop gravity algorithm with Wilson loop of graviphoton over link between their edge of free electron spinor field in Cooper pairs. The spinor network and quantum holonomy can be implemented with Ising algorithm of quantum machine learning [39] to find the order parameters in the wormhole structure. We assume that in superconductor state in wormhole, the state is coherent and the energy of states cannot be lost with respect to changing gauge field in the Chern-Simons current. When we change free energy, the superconductor magnetic flux will not change up to some threshold. We quantize free energy of Cooper pairs in the wormhole by using moduli state space model of the Chern-Simons forms A_1, A_2, A_3.

In gauge theory, A_μ is a gauge field and also can be realized as Wilson loop. Traditionally we represent an electric field or electromagnetic field with the field strength $F_{\mu\nu}$, a Yang-Mills field. In the Chern-Simons theory, A_μ is represented a general field for any fields to be unified. In this work, we use A_μ for the field of attributes of the electron to be learned within supersymmetric support Dirac network. These attributes are induced by three types of molecular orbital of carbon lattice in graphene wormhole.

Definition 1 *Let A be a connection along spinor field of the Cooper pairs. Let $A\partial A$ be a coupling between two connection fields, one is from hexagonal carbon ring of graphene as an edge A of spinor network, the other ∂A is from localized electrons around $3sp^2$ bonding of carbon atom. We use wedge product of three bonds and denote it as the*

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Peer-reviewed version available at *Symmetry* **2020**, *12*, 774; doi:10.3390/sym12050774

Chern-Simons 3-forms $A \wedge A \wedge A$.

In molecular orbital of the graphene with repeated N carbon atoms, the trajectory of an electron is visualized by energy band. We alternative use new methodology to visualize the energy band by using a partition function over free energy. The orbital induces from the supersymmetry of group operation of principle bundle of the connection. The trajectory of free electron can be knot state of modified Wilson loop with the spin invariant. The connection of spinor field gives a parallel transport of free electron along hexagonal carbon atom in the equilibrium state of superconductor (see Fig. 1).

Let X_t be Kolmogorov space of time series data of trajectory of Cooper pairs. The loop is coming from the choosen point of momentum space of free electron $[\mathrm{e}^{\mathrm{i}kx}] \in [S^1, X_t]$ with equivalent class of fundamental group $\pi_1(X_t)$.

Definition 2 *Let A be a connection of Cooper pairs. We define the equilibrium state of Cooper pairs with partition function*

$$Z = \mathrm{e}^{-\beta F} = k \int D[A_1] \wedge A_2 \mathrm{e}^{-\mathrm{i}S} \tag{1}$$

with choosen action of the system equal to one form of the third connection in carbon lattice $\mathrm{i}S = \wedge A_3$.

Definition 3 *The canonical form of the Chern-Simons supercurrent in a graphene wormhole is an equilibrium state of parallele transport of Cooper pairs along 3-form of connections over 3 carbon rings of 6 carbon atoms per rings with canonical state k of partition function. The formula is*

$$J^{k=\beta} = k \int A \wedge dA + A \wedge A \wedge A. \tag{2}$$

In the equilibrium of parallel transport, the current is conserved free energy for moving Cooper pairs so we have the change of path integral to differntial form over cohomology $D[A] = dA$. Since $Z = k \int D[A_1] \wedge A_2 \mathrm{e}^{-\mathrm{i}S} = k \int D[A_1] \wedge A_2 \mathrm{e}^{\wedge A}$. We approximate $\mathrm{e}^{\wedge A} \simeq 1 + \wedge A + \cdots$ so we have

$$J^k = k \int dA \wedge A(1 + \wedge A) = k \int A \wedge A + A \wedge A \wedge A. \tag{3}$$

with $k = 1, 2, 3 \ldots$ as a partition function of states of trajectory of Cooper pairs as modified Wilson loop in framework of behavior of electron as codifferential map of cochain complex. We have

$$F \in C_6(X_t) \xrightarrow{d} dF \in C_5(X_t) \tag{4}$$

if we consider a space trajectory of the Cooper pairs X_t over carbon lattice $C_6(X_t) = \langle \langle e_1, e_2, \cdots, e_6 \rangle \rangle$. It is a CW complex span by cell as the edge of ribbon graph $E = \{e_1, e_2, \cdots, e_6\}$ with the connection A for each edge. In each cell complex, we have partition function $Z = \mathrm{Ker}(d)$ as the equilibrium state for coherent superconductivity state of the Cooper pairs with exact sequence of infinite cohomology $d^2 = 0$.

We define kernel function as partition function with Lie derivative in the form of exponential. So we have a general form of the supercurrent by $J = \frac{\partial F}{\partial \varphi}$ with

$$Z = \mathrm{e}^{-\beta F} = \int D[\Psi] D[\Psi] \mathrm{e}^{-S(\Psi, \Psi)}. \tag{5}$$

Definition 4 *A cohomology of free energy in graphene wormhole is composed of chain complex of carbon lattice with three types of connection A_μ, A_μ^L, A_μ^R of gauge field for an electron.*

In this model the first cohomology group is a ribbon graph of spinor network. We assume that the supercurrent is the Chern-Simons current over holonomy of the Cooper pairs along ribbon graph of carbon lattice. The connection A_μ is a modified Wilson loop from our definition above. The behavior of electron parallel transport can be expressed by the coupling between these connection gauge fields. The attribute A_μ is also having some extraproperty as behavior of supersymmetric Dirac neuron network in our new model of quantum machine learning. We have an expectation of the attribute as group action with fixed point of gauge group in the mirror symmetry gauge group action along the ribbon graph of carbon lattice

$$\langle A_\mu \rangle = \frac{1}{Z} \int \Pi_i W_i A_\mu \mathrm{e}^{-\mathrm{i}S}. \tag{6}$$

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B. Geometry of the Cooper pairs

Decomposition of the Cooper pairs while tunneling through Josephson junction in a wormhole, switch spin orbital of Cooper pairs electron from the left chiral supersymmetry to right chiral supersymmetry in the superconductor junction of child manifold through normal junction of the Chern-Simons manifold. The mechanism of phase shift in the tunneling produces a graviphoton by inducing the Chern-Simons supercurrent in fifth dimensional extension of fourth dimensional model of double graphene sheet. We assume that energy is conserved over extradimension in the form of exact sequence of cohomology of free energy. The Cooper pairs tunnel from fourth dimension to fifth dimension by using the differential operator over chain complex of superspace. The distortion of fifth dimension produces a gravitational curvature as graviphoton mass produces two electrons in the Cooper pairs separated to each other inside the graphene wormhole. This mechanism is in analogy with quantum entanglement state in quantum information theory with warping state as entanglement states of the Cooper pairs. The supercurrent is produced by changing phase of the Cooper pairs from child1 manifold to child2 manifold with starting superconductivity as the supercurrent. Our theoretical study is based on the superspace of two sheets of graphene in $(2+1)+(2+1)$-dimensional model with $\dim(\mathbb{R}\times X_t^L\times Y_t^R)=5$ where X_t^L is a left child manifold of graphene sheet with the left chiral supersymmetry and Y_t^R is a right child manifold of graphene sheet with the right chiral supersymmetry and the extradimension $\mathbb{R}$ is a dual superspace of graphene $X_t^L\times Y_t^R$ with real ground field as fifth dimension.

In this section, we relax some properties as curvature, connection, Yang-Mill field and Dirac operator by adding new properties to definitions of modified Dirac operator and supersymmetric support Dirac network just for the purpose to study specific property of the Chern-Simons current in the superspace of extradimensions.

We consider connection A_1, A_2, A_3 between two molecules of graphene in the wormhole as a simple example of two child manifolds X_t, Y_t with single bond link X_t/Y_t between them as the Chern-Simons manifold. We can use this model to extend on more carbon molecules in child manifold and add some extra carbon molecules to the Chern-Simons manifold in next steps by using optimization along spinor network. One graphene molecule is hexagonal without defect. The other molecule is pentagonal with one defect. The CS-bridge connects bonding of carbon atoms and induces a closed surface with the curvature and graviphoton as connection of all electrons to free move around closed surface of free energy for N combination of hexagonal and pentagonal carbon molecular lattice of graphene.

Let homotopy path over manifold of pentagon S^5 be a homotopy from deformed crystal lattice distance between pointed space of time series data as ground gauge field without exitation $\mathbb{H}P^1$ of free electron in bonding to pentagon by using the path $\alpha: S^5\times I\to X_t$. Giving a projection map $S^5\to S^4$, we take a covariant functor to the trajectory of Cooper pairs free electrons in the wormhole with curvature of topological defect in child manifold X_t by

$$\underbrace{[S^5,X_t]}_{\text{layer3}}\overset{d}{\to}\underbrace{[S^4,X_t]}_{\text{layer2}}\overset{d}{\to}\underbrace{[S^3,X_t]}_{\text{layer1=spinor}}\ ,\tag{7}$$

so we have

$$C^5(X_t)\overset{d}{\leftarrow}C^4(X_t)\overset{d}{\leftarrow}C^3(X_t)\tag{8}$$

in which a cohomology group is induced by using kernel map from a conservation of free energy in fifth dimension. We define Hamiltonian of the global system by using the differential map in chain sequence with moduli state space of kernel and image map in $H_4(X_t)=\mathrm{Ker}\big(\partial(C_5(X_t))/\mathrm{Im}(\partial(C_4(X_t)))\big)$ and turn an arrow from covariant functor to contravariant functor to produce a gauge field of deformed curvature of spinor field as induced gravitomagnetic field with graviphoton mass as source from

$$\mathrm{Ker}\big(\partial(C_4(X_t))\big)=\{B_g|\bigtriangledown:C_4(X_t)\to C_3(X_t),\bigtriangledown\cdot B_g=0,B_g\in C_4(X_t)\}\tag{9}$$

of crystal bending covalent bond from hexagonal to pentagonal

$$\cdots\to H^3(X_t)\to H^4(X_t/Y_t)\to\cdots.\tag{10}$$

Consider the other side of D-brane with induced operator D^+ and anti-D-brane D^- with a trajectory of free Cooper pairs electronic spin in Kolmogorov space as ground state of S^4 with covering space $Y_t=:S^7$. Consider homotopy path of Hopf fibration from $S^7\to S^4$ with group action of spinor field of graviphoton in mirror symmetry for quantum tunneling $S^3\to S^7\to S^4$. Take a covariant functor as above and we get a cohomolgy group.

The tunneling in the wormhole induces a graviphoton over Hopf fibration and violent of CPT model as warping of electron across tunnelling. In this section, we compute hidden 8 states of graviphoton with spin 1. The states of graviphoton can be interpreted as qubit state over Hopf fibration $S^3\to S^7\to S^4$.

We define three cohomology sequences, a sequence of free electron T_1, an external magnetic supercurrent field of photon T_2 and a qubit memory holding states of graviphoton T_3. The coupling between these cohomology sequences

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induces an chiral state $\varphi^{\mu}_{L}(T_1,T_2,T_3)$ from left hand to right hand $\varphi^{R}_{\mu}(T_1,T_2,T_3)$ by deformed curvature of spacetime in the wormhole with changing cohomolgy connections.

Physical interpretation of a monopole or an instanton in the graphene crystal is equivalent to quantum tunneling in the semiclassical scale of wormhole connected by single group graphene molecules from different sides of Einstein-Rosen bridge as child1 and child2 manifolds. The Chern-Simons manifold is equivalent to the length of group of crystal of graphene as a single coupling constant.

Let a general solution induced from the trajectory of 3-orbitals between the coupling of Cooper pairs and graviphoton can be written in the general form of coupling between three cosines with unknown frequency and amplitudes of energy of states is written as

$$\varphi_{\mu=k}(T_1,T_2,T_3) = A\cos(\theta_1) + B\cos(\theta_2) + C\cos(\theta_3). \tag{11}$$

The first term induces from tensor correlation between the graviphoton and others, the second and third terms are equivalent in the construction. We consider a mirror symmetry to $\varphi_{\mu=k}(T_1,T_2,T_3)$ written in the form

$$\varphi^{\nu=k}(T_1,T_2,T_3) = A\sin(\theta_1) + B\sin(\theta_2) + C\sin(\theta_3). \tag{12}$$

Let $J^{\mu=k} = \frac{1}{\text{Volume}} \frac{\partial R^{Y_t/X_t}_{T_1,T_2,T_3}}{\partial \Gamma_{dT_1\wedge dT_2\wedge dT_3}}$ be a partition function as a boundary volume 3-forms S^3 over the superspace of graphene wormhole. We explicitly approximate the current to boundary in S^3 by

$$\begin{aligned}
J^*_{\varphi^{\nu=k}(T_1,T_2,T_3)} &= \Big\langle \int_{\partial H^n H^{n+3}(X_t/Y_t)} DA e^{\mathrm{i}S_{CS}}, \\
&\int_{\partial H^n H^{n+3}(X_t/Y_t)} DA e^{\mathrm{i}S_{CS}}, \\
&\int_{\partial H^n H^{n+3}(X_t/Y_t)} DA e^{\mathrm{i}S_{CS}} \Big\rangle J_{\varphi^{\nu=k}} \\
&\simeq \frac{1}{\mathrm{i}} \ln \Big\langle \sqrt{\frac{2}{k+2}} \sin\Big(\frac{\pi}{k+2}\Big), \\
&\sqrt{\frac{2}{k+2}} \sin\Big(\frac{\pi}{k+2}\Big), \sqrt{\frac{2}{k+2}} \sin\Big(\frac{\pi}{k+2}\Big)\Big\rangle \\
&\simeq \Big(\frac{2}{k+2}\Big)^{\frac{3}{2}} \frac{\partial R^{Y_t/X_t}}{\partial \Gamma_{dT_1\wedge dT_2\wedge dT_3}} \\
&= \frac{\int DA e^{\mathrm{i}\int \Gamma\Gamma\Gamma+\Gamma\Gamma} \langle T_1,T_2,T_3 \rangle \Pi W(\Gamma)}{\int DA e^{\mathrm{i}\int \Gamma\Gamma\Gamma+\Gamma\Gamma} \langle T_1,T_2,T_3 \rangle}.
\end{aligned} \tag{13}$$

Let X_t be a superspace of child1 and Y_t be a superspace of child2. The Chern-Simons bridge is denoted by moduli state space Y_t/X_t in which can twist to X_t/Y_t by using Wilson loop operator in supersymmetry inside the wormhole. We define a superconductor junction in graphene wormhole by spectral sequence of sheave cohomology over section of vector field of graphene in the wormhole. Let 0_D (D – D-brane, AD – anti-D-brane) be a pointed space of starting states of Cooper pairs from the layer of D-brane

$$0_{Dbrane} \to \mathcal{O}_{X_t} \to \mathcal{O}_{Y_t} \to \mathcal{O}_{Y_t/X_t Chern-Simons} \to 0_{AD}. \tag{14}$$

In order to link between D-brane 0_D and anti-D-brane 0_{AD} one needs a supersymmetry to warp between sheet without loosing time. In order to do that one need to define BV-cohomology [40] for the superspace of graphene wormhole $(\mathcal{A}, s)$.

The chain complex of carbon atoms in graphene lattice we denote by $C_*(T_1,T_2,T_3)$. Let $H^n H^{n+3}(T_1,T_2,T_3)$ be BV-cohomolgy model for the superspace of graphene wormhole defined by warping between twistor of 2 sheets in the Chern-Simons manifold with Cooper pairs production of graviphoton. The stable orbital is defined as

$$H^n H^{n+3}(T_1,T_2,T_3; X_t/Y_t) = \mathrm{Im} C_*(T_1,T_2,T_3)/\mathrm{Ker} C_*(T_1,T_2,T_3). \tag{15}$$

We take a contravariant $[\cdot, X]$ functor with ground base space X to the commutative diagram, Table I. In fifth dimension, we have the image of differential map from homotopy class $[S^5, X] \xrightarrow{\partial_{X_t/Y_t}} [S^4, X] \xrightarrow{\partial_{X_t/Y_t}} [S^3, X]$ with the image map from fifth dimension to fourth dimension defined by $\mathrm{Im}(\partial_{X_t/Y_t}([S^5, X]))$. The image modulo kernel map is defining the coupling of graviphoton in fourth dimension with homotopy equivalent to S^4 (a moduli space based space of Hopf fibration $S^3 \to S^7 \to S^4$) as space of graviphoton. In fourth dimensional model of graphene wormhole, we define a superspace of Cooper pairs orbital as following

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$$
\begin{array}{ccccccccc}
0_D & \xrightarrow{T_1} & [S^7, X] & \longrightarrow & [S^3, X] & \longrightarrow & [S^{-4}, X] & \longrightarrow & 0_{AD} \\
\downarrow & & \downarrow & & \downarrow & & \downarrow & & \downarrow \\
0_D & \xrightarrow{T_2} & [S^5, X] & \xrightarrow{\partial_{X_t/Y_t}} & [S^4, X] & \xrightarrow{\partial_{X_t/Y_t}} & [S^3, X] & \longrightarrow & 0_{AD} \\
\downarrow & & \downarrow & & \downarrow & & \downarrow & & \downarrow \\
0_D & \xrightarrow{T_3} & [S^3, X] & \longrightarrow & [S^7, X] & \longrightarrow & [S^4, X] & \longrightarrow & 0_{AD} \\
\downarrow & & \downarrow{\scriptstyle \text{child1}} & & \downarrow{\scriptstyle \text{child2}} & & \downarrow{\scriptstyle \text{CS}-\text{bridge}} & & \downarrow \\
0_D & \xrightarrow{T_{CS}} & [\mathcal{O}_{X_t}, X] & \longrightarrow & [\mathcal{O}_{Y_t}, X] & \longrightarrow & [\mathcal{O}_{Y_t/X_t}, X] & \longrightarrow & 0_{AD}.
\end{array}
\tag{16}
$$

Table I. The commutative diagram.

Definition 5 *Let $e_u \in S^3$ be a free electron orbital of one separated free electron around one lattice of carbon atom in the graphene with homotopy equivalent to unit sphere S^7 of the Cooper pair with spin orbital $\varphi_u \in S^3$, $\varphi = \mathrm{e}^{\mathrm{i}\beta_i x_t}$. For the other part of the Cooper pair, $e_v \in S^7$ is a free electron orbital of separated free electron around one lattice of carbon atom in the graphene with homotopy equivalent to unit sphere S^7 of Cooper pair with spin orbital $\varphi_v \in S^3$, $\varphi = e^{i\alpha_i y_t}$. An orbital of Cooper pairs is $\Phi_i = [1, \sum_{\nu\mu} g_{\mu\nu} e_\mu e_\nu / \varphi_\mu \varphi_\nu] \in \mathbb{HP}^1$, it is Hopf fibration $S^3 \to S^7 \to S^4 = \mathbb{H}P^1$.*

Definition 6 *Let a Josephson effect for the Cooper pairs be defined by the connection between Cooper pairs wave function and graviphoton in extradimension warp between fourth dimension and fifth dimension. We denote the connection from free electron to wall of space border to fifth dimension by $\Gamma_{\mu\nu}$. We define an instantaneous phase shift from one superconductor junction to another superconductor junction by a curvature $R_{\mu\nu}$ in an amount of warped time in $\Gamma_{\mu\nu}$. The equation of Josephson $-\mathrm{i}h\frac{d\Phi_i}{dt}$ can be transform to the equation over curvature of fifth dimension by $\frac{\partial R_{\mu\nu}}{\partial \Gamma_{\mu\nu}}$.*

We define the Chern-Simons current in 5-dimensional model and in 11-dimensional model with the application to transport free electron to graphene wormhole. Let $R_{\mu\nu}$ be a curvature of electron trajectory homotopy path with the spin in parallel and anti-parallel direction to its momentum. Let dt^* be a distance between atoms in the graphene with defect inducing curvature. The fifth dimensional model is denoted by the Hopf fibration. We use metric on Ricci flat cone superspace

$$ds^2 = dt^2 + g_{ab}(t) e^a(k) \otimes e^b(k) + dt^{*2} \tag{17}$$

where $e^a(k)$, $e^b(k)$ are the Cooper pairs orbitals in Hopf fibration in which are self dual between D-brane and anti-D-brane of graphene child manifold $[X_t/Y_t, 1]$. The curvature R_{ab} deforms the superspace in wormhole between the connection in Dbrane a and anti-D-brane b. We define current in 5 dimensions $ds^4 = \langle dt^2, dt^{*2} \rangle$, by gluing four unit spheresS^1 by disjoint sum $S^1 \vee S^1 \vee S^1 \vee S^1$. Let $X_t := S^7$ be a Kolmogorov space of free electron in the wormhole. We use homotopy path $\alpha : X_t \times I \to S^3$ for the projection from extradimension to 4-dimensional D-branes. We have Hopf fibration S^3 acting on a fibre of tangent space S^7 to orbit based space in S^4. The current metric in the wormhole is defined over $S^4 \vee S^{-4} \simeq S^0$ as stable pointed space embeded in 11-dimensional manifold in which can be contractible to the Chern-Simons child manifold over S^3, a principle bundle orbit of Cooper pairs with self-dual two form over S^4 with presentation of Lie algebras as the Chern-Simons 3-forms connect two child manifolds as Einstein-Rosen bridge in superconductor grahene wormhole model.

The Chern-Simons current is an axial correlation and projection from 5-dimensional model of D-brane into 4 dimensions by using 3-forms as a main tool for the measurement of induced changing volume of interaction flux of gravitational field with magnetic field in 3-vector fields with their induced dual fields in AdS -Yang-Mill fields. The superspace of graphene composed of tensor product of 3-forms in 4-dimensional model of the Chern-Simons form glues up into the superspace with modulo $\mathbb{Z}_4 \subset S^4_{\mathbb{Z}} := S^1_{\mathbb{Z}} \vee S^1_{\mathbb{Z}} \vee S^1_{\mathbb{Z}} \vee S^1_{\mathbb{Z}}$. We can use the Chern-Simons 3-current to measure the interaction between two D-branes in the graphene as metric of Lie algebras 3-forms of imaginary map modulo kernel projection map in cohomology theory.

Definition 7 *Let X_t be a Kolmogorov space of trajectory of a pair with $X_t = S^7$ Hopf fibration of free electrons inthe wormhole. he superspace with dimension $n+n+4 = 2+2+4 = 8$ of graphene wormhole is defined by homotopy class*

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deformed in double plane (one time deformed in D-brane and one time in anti-D-brane simultaneously) with moduli space of the Chern-Simons 3-forms

$$H^nH^{n+3}(X_t) = [H^{n+3} \to S^{n+3}] \to S^n \to \cdots \to S^0 \to 0. \tag{18}$$

The element form by simple equation similar with modified Nahm equation of the coupling between three Lie algebras in 11-dimensional model with string X^i in the superspace in projection to i-dimension. In 3-dimensions we have a moduli superspace of the graphene between three string couplings with the curvature of graviphoton in three bonds of deformed hexagon of graphene wormhole by

$$J^{\mu=1}([c_i])X^1 + J^{\mu=2}([c_j])X^2 + J^{\mu=3}([c_k])X^3 = \frac{\partial R^{\mu}_{ijk}}{\partial \Gamma^k_{ij}} \mod J^{\mu}, \tag{19}$$

for $i, j, k = 1, 2, 3,\ J^{\mu} \in \mathrm{Tr}H^3(X_t)$.

Let $\oint_{\text{Cooper}} p_s \cdot dl$ be an integral of the momentum of Cooper pairs, let ΔJ^{μ} be the Chern-Simons current. We moduli superspace of free energy in the wormhole by a quantization of the coupling between the momentum of Cooper pairs and induced Chern-Simons currrent from the graviphoton $\Delta J^{\mu}_{\text{graviphoton}}$. We have

$$[X_t/Y_t, 1] \ni \frac{\Delta 2 \oint_{\text{Cooper}} p_s \cdot dl}{h\Delta J^{\mu}_{\text{graviphoton}}} = n \in \mathbb{Z}, \tag{20}$$

where Proca equation for full canonical momentum of the Cooper pairs including gravitational fields is given by

$$\Gamma_{X_t/Y_t} \simeq F = dA + \underbrace{[A, A]}_{0} = \oint \nabla \times A = \oint_{\text{Cooper}} p_s \cdot dl = \oint (m^* v_s + e^* A_{\mu} + m^* A_g) \cdot dl = \frac{nh}{2}. \tag{21}$$

Let the orbital of graviphoton belongs to the tangent of manifold one form with Lie algebra as tangent of graviphoton manifold $\Phi_{\text{graviphoton}} := X^{\rho}$, the Cooper pairs in left chiral state are $\Psi_{\text{Cooper-pairs}} := X_{\mu}$ and $\Xi := X_{\nu}$. The right chiral state of the Cooper pairs in mirror symmetry is denoted by X^{μ} and X^{ν} in dual one form over the manifold of the Cooper pairs. We glue three orbitals as coherent states in the Chern-Simons 3-forms over $\mathrm{Tr}H^3(X_t)$. The trace invariant is measured by Hermitian product over the tangent of supermanifold, we denote by Chern-Simons current the density in superconductor states in graphene wormhole $J^* = \langle \Phi J^{\mu} \Psi \Xi \rangle = \langle T_1, T_2, T_3 \rangle$ as a group action of Hopf fibration over tangent space of Calabi-Yau orbifold in new quantum foam model for superconductor. We will compute the integral for finding the optimal Chern-Simons current in superconductor state with the radius of wormhole in the next section.

Consider a space of fourth dimension with the curvature $R^{X_t/Y_t}_{T_1,T_2,T_3}$. The volume form in the Chern-Simons graphene wormhole with free energy of coupling between the graviphoton and Cooper electron pairs can be written as the equation with boundary condition as

$$\Delta E(\Gamma) = \frac{\partial R^{X_t/Y_t}_{T_1,T_2,T_3}}{\partial \Gamma_{T_1} \wedge \partial \Gamma_{T_2} \wedge \partial \Gamma_{T_3}} \mod J^*, \tag{22}$$

where Γ_{T_i} $(i = 1, 2, 3)$ is a connection over fibration, the components of graphene wormhole superspace modelling. The moduli term signifies quantum states with warping of an electron around graviphoton in the confinement production as gluon exchange particle since we transform the equation above with the energy state by

$$\Delta E(\Gamma) - \frac{\partial R^{X_t/Y_t}_{T_1,T_2,T_3}}{\partial \Gamma_{T_1} \wedge \partial \Gamma_{T_2} \wedge \partial \Gamma_{T_3}} + nJ^* = 0, \tag{23}$$

where $n \in \mathbb{Z}$ and (d_x, d_y) is 2-dual basis span over lattice of graphene D-brane in 2-dimensions, $\text{basis}(J^*, \Delta E(\Gamma)) = d_x$, $\text{basis}(J^*, \partial\Gamma_{T_1} \wedge \partial\Gamma_{T_2} \wedge \partial\Gamma_{T_3}) = d_y$.

The process is a quantum foam model of confinement similar with gluon exchange of a quark and an antiquark to produce knot in modified Wilson loop of graviphoton.

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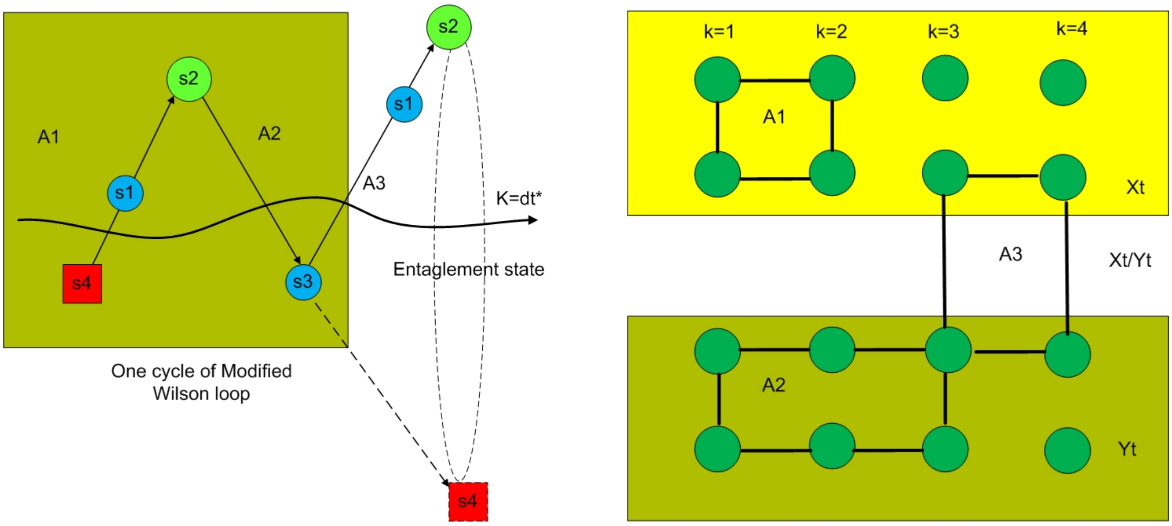

Figure 2. On the left: the visualization of Wilson loop as spinor field in time series data. On the right: the visualization of modified Wilson loop over lattice of carbon atoms.

C. Supersymmetric support Dirac network

A supersymmetric support Dirac network (SSDN) is a support spinor network with some extraproperties of attachment of modified Dirac operator for each edge with a capacity of the Chern-Simons current in the form of modified curvature keeping in each three types of nodes. They represent three types of molecular orbital of graphene carbon atom with a holonomy of spin connection. It is a network of coupling between the Cooper pairs and graviphoton in superconductivity states with underlying superspace of ribbon graph model of induced supersymmetric support Dirac machine. The SSDN algorithm is the extended algorithm of quantum machine learning of the Ising model for phase transition [41] by using convolutional neural network. We let curvature $R^i_{\mu\nu}$ be a capacity over ribbon graph node. The Hamiltonian operator is defined over the ribbon graph with maximum flow of the holonomy of connection algorithm along closed loop in the ribbon graph. We use the definition of modified Wilson loop over spinor network over equivalent of loop of trajectory of Cooper pairs in the graphene carbon lattice atoms with pentagonal defect inside a wormhole structure. The annihilation and creation operators around vertices along the loop are defined with modified Dirac operator for warping D-brane of Cooper pairs. In equilibrium state of starting superconductor with the classification of spinor network, we have an optimization of total curvatures along modified Wilson loop with total curvature in superconductor state of the system equals zeroe

$$\sum_i R^i_{\mu\nu} = 0. \tag{24}$$

The holonomy operotor of ΠW_i is defined by a flow of flux quantum in the form of a connection $\Gamma_{\mu\nu} = A_{\mu\nu}$ along the edge in ribbon graph. We define SSDN for graphene wormhole which is composed of three types of modified Dirac operators for measuring the Chern-Simons current flow over supersymmetric spinor network. For the left and right supersymmetry of the Cooper pairs it is J_1 and J_2 and for the graviphoton it is J_3. We have three types of nodes with total number of carbon atoms N. The first type is a superconductor child1 node X_t with $C_n(X_t)$ as n chain of the Cooper pairs in the ribbon graph node. The second type is a superconductor child2 node Y_t with $C_n(Y_t)$ as n chain of the Cooper pairs in the ribbon graph node. The third type of node is a normal state of Josephson junction with the chain of tunnel Cooper pairs as $C_n(X_t/Y_t)$. The spinor network of ribbon graph for lattice structure is shown in Fig. 2.

Definition 8 *A modified Dirac operator for the left chiral fermion is defined by turn mirror symmetry of D-brane to anti-D-brane with reversed time scale dt^*. We let $\mathrm{i} = \sqrt{-1}$ be an imaginary number representing hidden time scale in the extradimension perpendicular with D-brane*

$$D^- = -\mathrm{i}\Gamma^j(g^{ij}). \tag{25}$$

A modified Dirac operator for the right chiral fermion is defined by turn mirror symmetry of anti-D-brane to D-brane with time scale dt

$$D^+ = \mathrm{i}\Gamma_j(g_{ij}). \tag{26}$$

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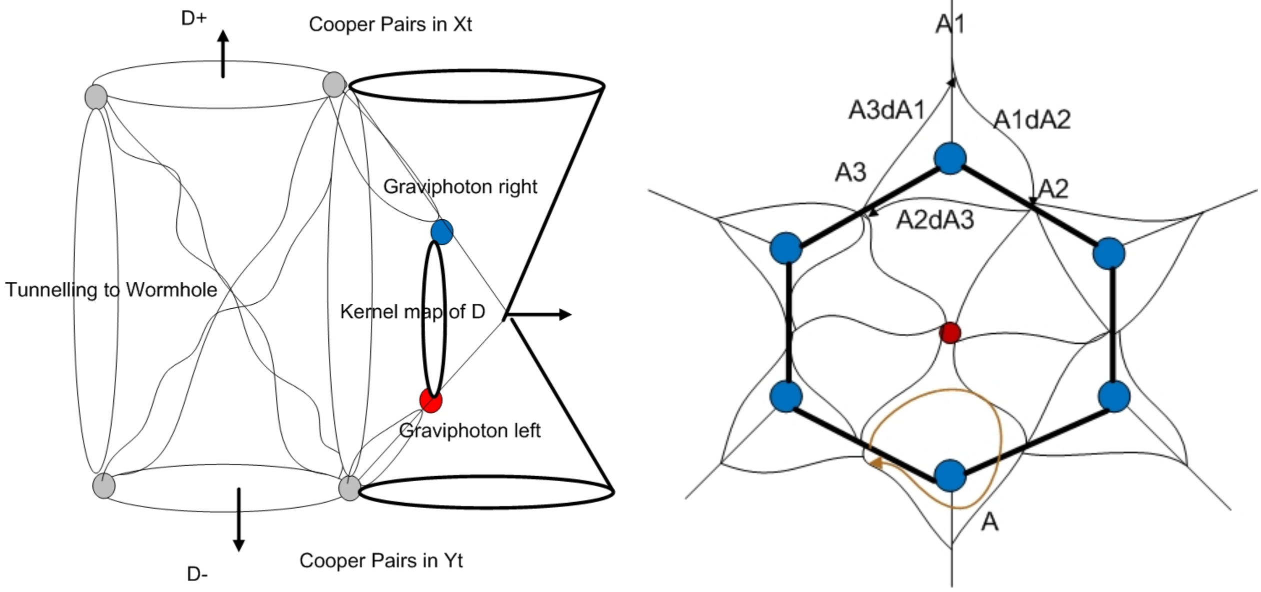

Figure 3. On the left: the tunneling of the Cooper pairs by warping operator through fifth dimension into a graviphoton. The kernel map of graviphoton projects them to the center of wormhole next lattice vibration of 4 dimensions. On the right: the modified Wilson loop $A_\mu = A_1dA_3 + A_2dA_1 + A_3dA_2$ where $AdA := \int D[A]A$. The gauge field A_μ is a flux quantum attached to the Cooper pairs in spinor field as a connection of spin. It is a holonomy of SSDM for new type of learning algorithm in convolutional spinor network.

We have

$$\begin{aligned} &D^{+,R}\Phi_{+,1,R} = J_1\Phi_{+,1,R}, \quad D^{+,R}\Phi_{-,1,L} = 0, \\ &D^{+,R}\Phi^3_\nu = J_1\Phi_{+,2,R}, \quad D^{-,L}\Phi_{-,1,L} = 0, \\ &D^{-,L}\Phi_{-,1,L} = J_2\Phi_{-,1,L}, \quad D^{-,L}\Phi^3_\nu = J_2\Phi_{+,2,L}. \end{aligned} \tag{27}$$

The supersymmetric Dirac operator is a symmetric operator so we have a coupling of annihilation and creation Dirac field in D-brane and anti-D-brane in the wormhole Chern-Simons manifold X_t/Y_t. The coupling can be considered as a warping state of the Cooper pairs over supersymmetry next carbon atom bonding in symmetric group action of modified Wilson loop of A_1, A_2, A_3 (Fig. 3). The mechanism is an entaglement states of physiology of end point of trajectory of Cooper pairs loop space of Kolmogorov space in time series data. We can explain it by a quantum confinement of the interaction between D-brane and anti-D-brane of the Cooper pairs (Fig. 4)

$$\{D^+D^-\} = 0. \tag{28}$$

The operator can react with a vertex of spinor network in the sense of quantum form of holonomy with the connection Γ_i to produce a change of curvature deformed from fifth dimension into supercurrent in fourth dimension in analogy with the electron-graviphoton interaction

$$\begin{aligned} &D\Gamma_1 = J_1, \quad D\Gamma_2 = J_2, \quad D\Gamma_3 = J_3, \\ &D^+J_1 = J_3, \; D^+J_2 = J_3, \; D^+J_3 = 0, \\ &D^-J_1 = J_3, \; D^-J_2 = J_3, \; D^-J_3 = 0. \end{aligned} \tag{29}$$

We define three types of vertices, S_{i,X_t}, N_i, S_{i,Y_t} $(i = 1, \ldots, n)$, with superspace parameters as a capacity hold inside the node. Let $S_{1,X_t} = (\Gamma_1, J_1, \Phi_{1,R})$ and $S_{1,Y_t} = (\Gamma_1, J_2, \Phi_{1,L})$ and $N_{1,X_t/Y_t} = (\Gamma_1, J_3, \Phi^\nu_3)$

Definition 9 *We define supersymmetric spinor network Dirac operator along N nodes of carbon atoms in the system of graphene wormhole,*

$$D^{\pm}_{\mathrm{spinor-network}} = \Pi_k \sum_{i=1}^{N} \left(\Gamma^k_{i,j} - \Gamma^k_{i+1,j}\right) | \, s_i s_j \, \rangle + h \sum_i s_i + E(dt^*) \tag{30}$$

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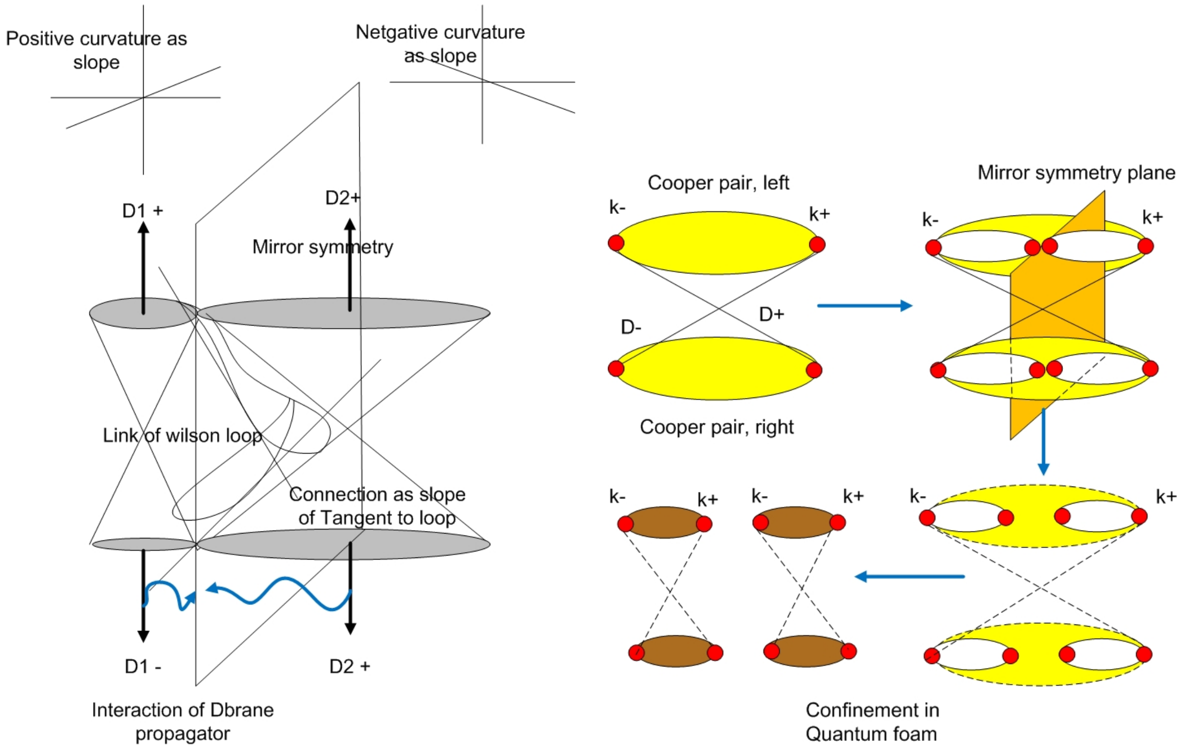

Figure 4. On the left: the interaction of D-brane with anti-D-brane warping operator to fifth dimension direction dt^t in the form of graviphoton wave with modified Wilson loop as link between the interection of curvature in ribbon graph in spinor network model. One the right: the confinement in quantum foam model on localized Cooper pairs in tunnel state. This state also can be considered as entanglement state in time series data when we reversed time scale of the model by rotating cone of events.

with predefined wave function with − for the left and + for the right configuration parameters as new order parameter where $A_k = \Gamma^k_{i,j}$, $k = 1, 2, 3$, *is the connection of the Cooper pair and graviphoton in the wormhole.* J^* *is a supercurrent and* $E(dt^*)$ *is free energy of the graviphoton in hidden fifth dimension.*

Let $G = (V, E, i)$ be a ribbon graph of spin network with involution map i. The vertex is defined by the accumulation of free energy of supersymmetric Dirac operator from the left and right supersymmetry wave function of the Cooper pairs free electrons. The edge is a supersymmetric Dirac operator

$$D^{\pm}_{\text{spinor-network}} \Phi_\mu = J^\mu_i \Phi^\mu_i \tag{31}$$

when the network is in a nonequilibrium of forbidden transition state in superconductor state, we have

$$D^{\pm} \Phi^\mu_i = 0, \qquad J^\mu_i = R = 0. \tag{32}$$

We define three types of coupling between the Cooper pairs and graviphoton by using the supersymmetric wave function with underlying ghost field $\Phi_\pm \in \{\pm 1\}$ with parity modulo exitation state. The ghost field Φ_+ is the right symmetry in child1 manifold S_{1,X_t} and the antighost field Φ_- is defined by the orbital of Coopers pairs in child2 manifold S_{2,Y_t} with the left symmetry. For Cooper pairs in normal junction of the coupling between graviphoton, we denote it $\Phi^{3,N}_\mu$. The modified Dirac operator in the superspace is defined by induced normal field to the superfield so we can split Dirac operator into the left and right supersymmetric Dirac operator $D^\pm$, with three types of supercurrent as the eigenvalue of anihilation and creation supersymmetric Dirac operator.

III. COMPUTATIONAL ALGORITHM FOR THE CHERN-SIMONS CURRENT

In this section, we present numerical simulation of the Chern-Simons current over spinor network of a graphene wormhole according to theoretical model described in the previous section. The simulation consists of three main steps procedure. First step is an algorithm to random choosen partition function of supercurrent J^k, $k = 1, 2, \ldots, N$, where

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N is an amount of carbon atoms in the graphene wormhole. In our simulation of left symmetry for the wormhole, we choose as an input example $N = 84$ atoms, 54 carbons for graphene D-brane, 18 carbons for child1 X_t and 3 carbons belong to the Chern-Simons bridge (see Fig. 5). The rest of carbon atoms is added as a bridge between these 3 structures. For the right symmetry of anti-D-brane, we assume symmetric structure of result. The real computation might contains more than 10 000 carbon atoms, which we cannot take into account here for reasons of time complexity of computation. The flowchart of our algorithm can be found in Fig. 6.

The second main step is an empirical analysis of frequency mode (FM) modulation of flux quantization for each lattice of the Chern-Simons current ($k = 1, 2, \ldots, 84$). The Holo-Hilbert transform is related to a new concept of cohomology sequence in extradimension of topological space with frequency modulation as the excitation of wave function of Coopers pairs. The expansion above is based on an adaptive intrinsic frequency mode function (ITD − IMF)chain$_1$(1) [12] as 3-basis of the Cooper pairs orbital $\Phi_\mu(dt^*)$, so we have

$$\Phi_\mu(dt^*) = x(dt^*) + \mathrm{i}y(dt^*), \tag{33}$$

and

$$x(dt^*) = \mathrm{Re}\sum_{j=1}^{3} c_j(dt^*) = \mathrm{Re}\sum_{j=1}^{3} a_j \mathrm{e}^{\mathrm{i}\int_{dt^*}\omega_j(\tau)d\tau} := \sum_{j=1}^{3} a_j \mathrm{e}^{\mathrm{i}\oint(p-q\Gamma_j)d\tau}. \tag{34}$$

The algorithm to find a spinor network with high-dimensional Holo-Hilbert spectrum of 3 layers of the Cooper pairs is iterative with 15 steps and it is shown in Fig. 7. The result of the algorithm is visualized by the spinor network of FM1, FM2, FM3 layers. The result of Holo-Hilbert amplitude is obtained as an extradimension representation where we can detect phase shift and classify the next state of a prediction of superconductor state by using the convolutional neural network (CNN). The nested expression for the amplitude of frequency in flux quantum is

$$a_j(t) = \sum_k \left[\mathrm{Re}\sum_l a_{jkl}(t)\mathrm{e}^{\mathrm{i}\int_t \omega_l(\tau)d\tau}\ldots\right]\mathrm{e}^{\mathrm{i}\int_t \omega_k(\tau)d\tau}. \tag{35}$$

The third used algorithm is the Ising algorithm of supersymmetric support spinor network. We use convolutional network so called Alexnet [42] to learn and predict spinor network with the size defined by number of nodes in spinor network. We choose input fixed size $84 \times 84 \times 3$, where 3 is coming from the connection of Cooper pairs, see Fig. 8. We find optimized size of the spinor network for hidden number of carbon atoms with probabilistic principle component analysis (PCA) algorithm [43] so called Laplace PCA and Bayesian PCA with Gaussian kernel. Both of them are new types of probabilistic PCA, typically used to find right dimensions of time series data by latent analysis of dimension reduction algorithm.

We assume that the hidden fifth dimension is parameterized by graviphoton field as flux quantum $B_e = \bigtriangledown \times g$, where g is gravitational field. We choose an arbitrary wave function for energy E^* of B_e with supercurrent as the amplitude in symmetric occupied state in 3-form of Cooper pairs from the coupling between the graviphoton and Cooper pairs

$$\begin{aligned} D^+\Phi_+ = J\Phi &= \sum_{i=1}^{3} D^+\Phi_{i,+}, J^k(dt^*)\Phi_k \\ &= S_1 \cos\left(\theta_{1,k}(dt^*)\right) + N\cos\left(\theta_{2,k}(dt^*)\right) \\ &\quad + S_2\cos\left(\theta^*_{3,k}(dt^*)\right), \end{aligned} \tag{36}$$

where S_1 is a superconductor tunnel operator for child1 manifold of superconductor. S_2 is a superconductor tunnel operator for child2 manifold of superconductor, N is a normal state tunnel operator for the Chern-Simons manifold and $\theta^* = dt^*$. Thus we have

$$\begin{aligned} J^* &= \min\sum_{i=1}^{3}\langle\, \Phi_{i,-}D^- \,|\, J_i \,|\, D^+\Phi_{i,+}\,\rangle \\ &= \sqrt{\frac{2}{k+2}}\sin\frac{\pi}{k+2}\Big[S_1\cos\left(\theta_{1,k}(dt^*)\right) \\ &\quad + N\cos\left(\theta_{2,k}(dt^*)\right) + S_2\cos\left(\theta^*_{3,k}(dt^*)\right)\Big]. \end{aligned} \tag{37}$$

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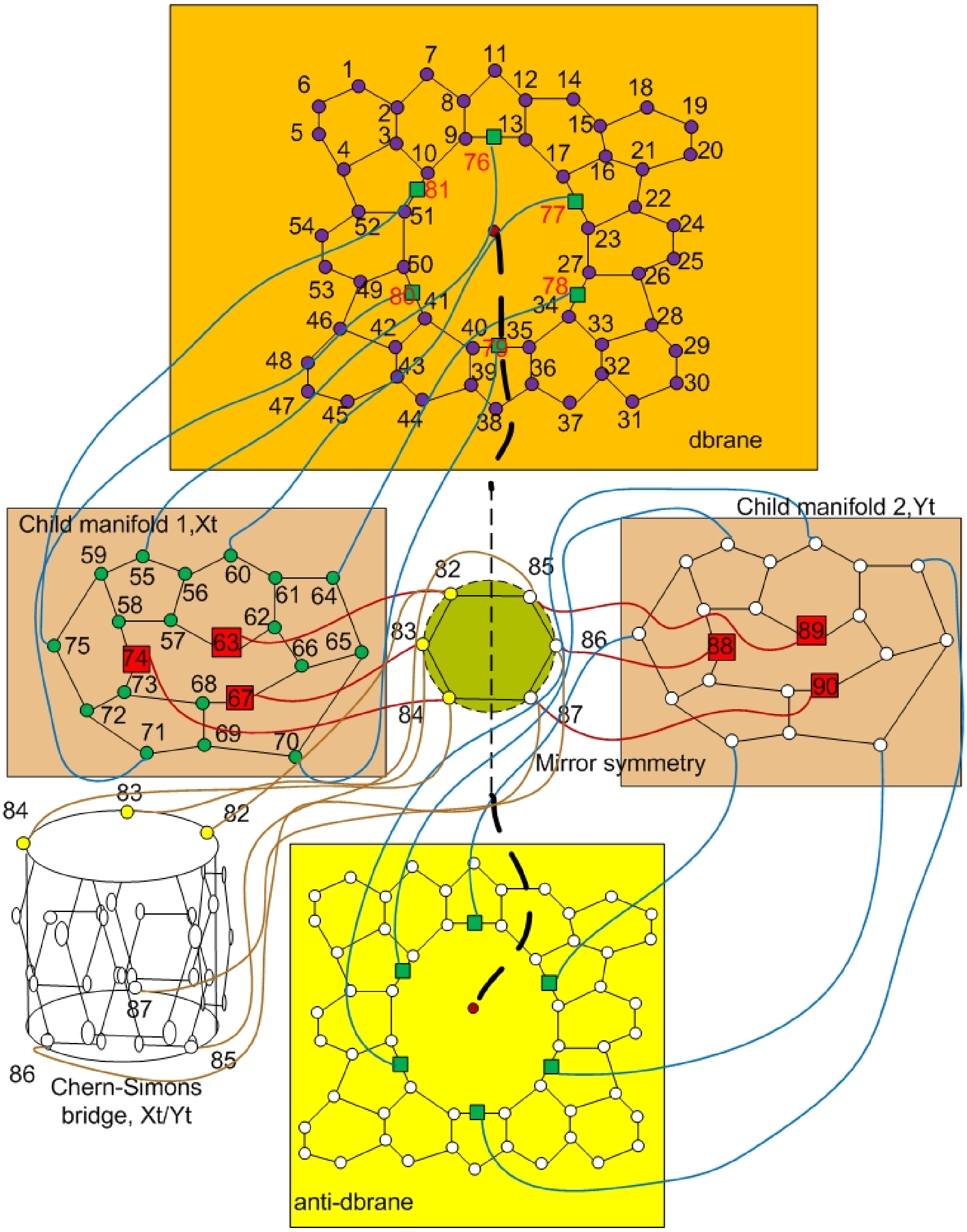

Figure 5. The spinor network of graphene D-branee with 54 carbon atoms is connected to child1 X_t manifold with 18 carbon atoms and the Chern-Simons bridge with 3 connected carbon atoms. The Chern-Simons manifold is composed of k carbon atoms located as the center of wormhole. The number $k = dt^*$ is the amount of extradimensional carbon atoms in this model. We want to find a number k, which can produce a stable wormhole structure with the Chern-Simons current as a supercurrent in superconductive state.

We can map from the space of carbon lattice to the space of energy band of the Cooper pairs, X_t/Y_t by the homotopy equivalent map $\alpha : S^6 \to X_t/Y_t$. The phase shift between tunneling X_t to Y_t is defined by

$$[1, \mathrm{e}^{\mathrm{i}\theta_{X_t}}/\mathrm{e}^{\mathrm{i}\theta_{Y_t}}] = [1, \mathrm{e}^{\mathrm{i}(\theta_{X_t} - \theta_{Y_t})}] \in X_t/Y_t. \tag{38}$$

The 3 occupied states of two valent states of the Cooper pairs and one valent state of graviphoton imply FM layer 3

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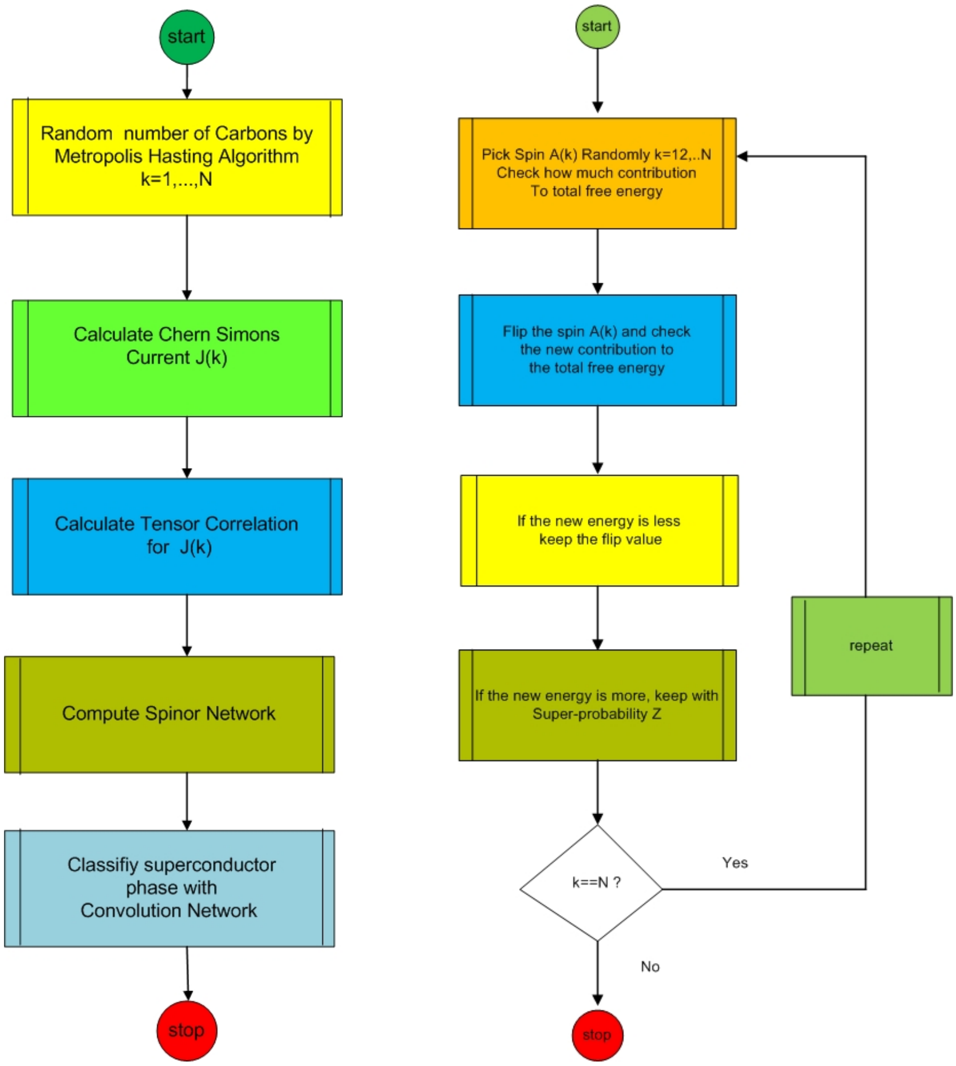

Figure 6. On the left: the flowchart of the algorithm for random initialized current 84 over carbon atoms in our simulation. On the right: the flowchart of Ising algorithm for for phase transition. We use these algorithms over fix structure of carbon lattice atoms as spinor network for Cooper pairs to be localized as parallele transport of free electrons.

of Holo-Hilbert spectral analysis of the energy band of a supercurrent. We implement spinor correlation matrix with Dirac operator of 3 states by using the frequency mode Holo-Hilbert analysis

$$\Phi_n(dt^*) = \mathrm{Re}\sum_{i=1}^{n} \mathrm{e}^{\mathrm{i}\int \frac{d\Phi_n}{dt^*}}, \quad n = 1, 2, 3, \tag{39}$$

for $n = 1$ we have a frequency modulation with the Cooper pairs in S_1 as energy surface of layer 1, for $n = 2$ a frequency modulation with the Cooper pairs in S_2 as layer 2 and for $n = 3$ a frequency modulation of the graviphoton in N as layer 3 in Holo-Hilbert spectrum.

The Ising model of SSDM in our model slices the window of each carbon lattice atom with modified Wilson loop $A_{\mu=k}$. We classify behavior of Cooper pairs free electron in spin up and down due to holonomy in spinor network with three types of connections, A_i $(i = 1, 2, 3)$ for each k. The spinor fields A_i are defined as the end point of physiology of spinor field in time series data for FM1, FM2 and FM3 layers. The spin up and down is the up and down direction of spinor field in time series data. For simplicity of simulation, we use only values $\{1, -1\}$ for Ising model. The Metropolis-Hastings algorithm [44] to flip the spin and to calculate free energy is defined as

- Calculate free energy for A_1, A_2, A_3 and sum them to find total free energy F^{tot}. For each modified Wilson loop $A_{\mu=k}$, the free energy is calculated by $F^{flip} = -2A_k(A_{k-1} + A_{k+1})$, $k = 1, 2, 3, \ldots, 84$.

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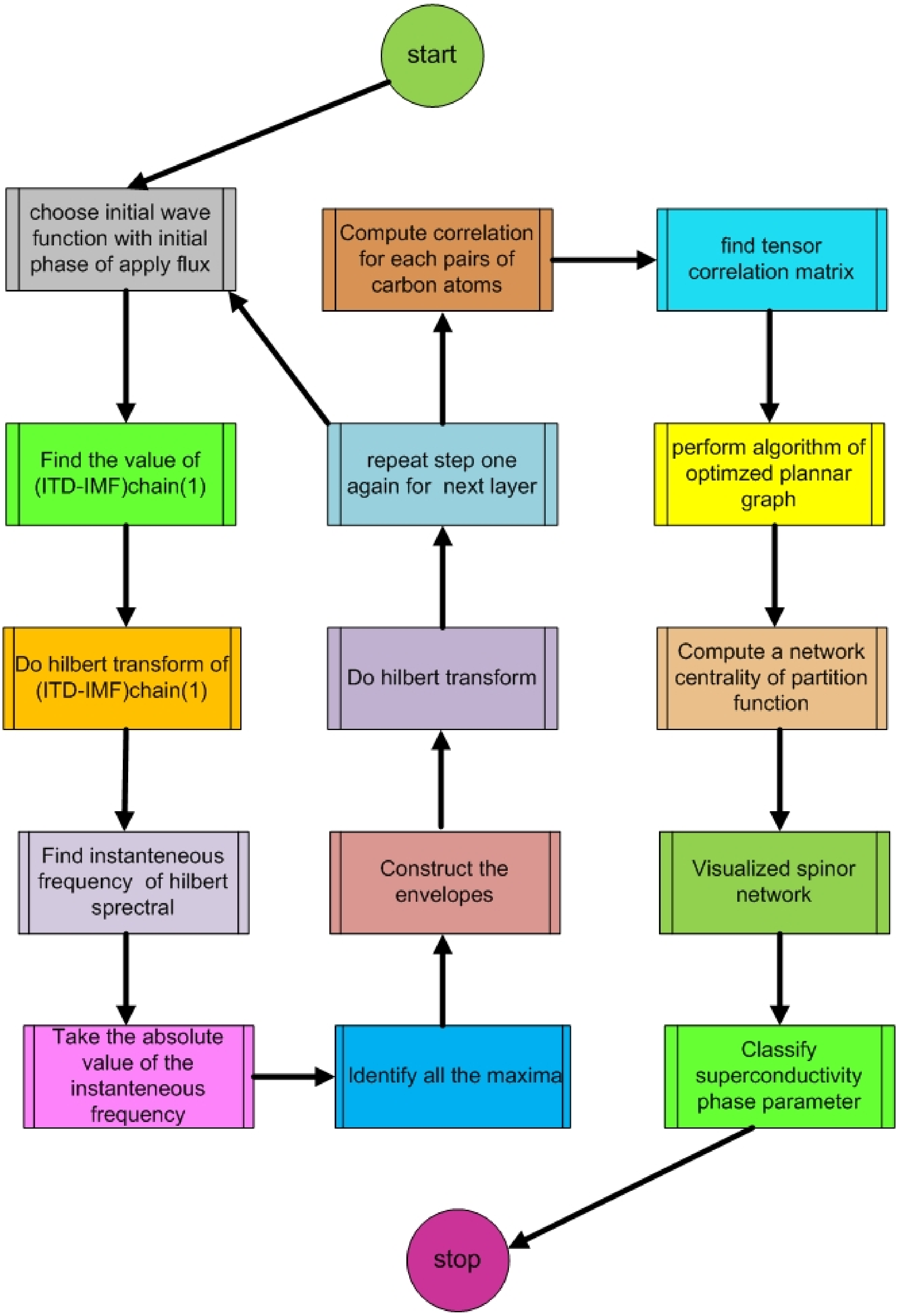

Figure 7. The flowchart of all involved modules for the classification of the Chern-Simons current and the prediction of graphene wormwhole size.

- If $F^{tot} < F^{flip}$ then keep A_μ.

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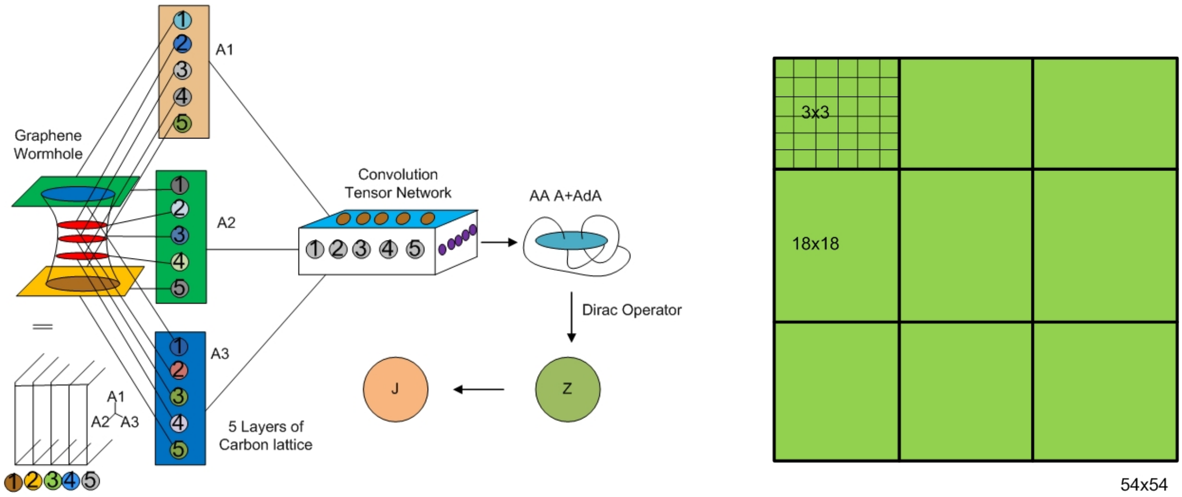

Figure 8. On the left: the algorithm of supersymmetric support Dirac network with CNN network and the input of 5 layers of tensor correlation matrix from the spinor network of graphene wormhole. The 1st layer is the carbon D-brane with 54 carbon atoms, the 2nd layer is child1 manifold X_t, the 3rd layer is the Chern-Simons manifold X_t/Y_t, the 4th layer is child2 manifold Y_t. The last 5th layer is the anti-D-brane layer of graphene with 54 carbon atoms. On the right panel we show the input of adjacent matrix to CNN for learning and classifying the order parameter.

- If $F^{tot} > F^{flip}$ then flip A_μ to the opposite direction.
- Repeat steps until $k = 1, 2, 3, \ldots, 84$.

We define phase order parameter for the superconductor T_c with $\beta = \frac{1}{k_b T_c}$ and assign to partition function for the classification and separation of wormhole plane into two planes by $Z = \mathrm{e}^{-\beta F}$ with choosen $T = T_c$ for plane separation. The input data for Alexnet are generated into two classes with target $0, 1$ for the normal state with class 1 and superconductor state with class 0. We then use Alexnet to learn and predict spinor network for these simulation data. In each node of spinor network representing the wormhole, we have the network of carbon atoms and Cooper pairs inside. We choose $0 < dt^* = k < L$ for a size of wormhole and choose a curvature for initial condition of spinor network $-1 < \Gamma_i = R < 1$, each node in spinor network randomly. Then we chose a predefined wave function of the Coopers pair to be $\Phi_k = \cos \beta_k$, where $[\beta_k] \in H_n(X_t/Y_t)$ for each carbon k. We compute Holo-Hilbert spectrum for frequency mode modulation of layer1, layer 2 and layer3 for spinor correlation between spin exchange in the excitations as spinor correlation network.

A. Simulation results of the Chern-Simons current along supersymmetric support Dirac network

The main objective of the paper is to predict the Chern-Simons current and the size of graphene wormhole as the stable structure. We use quantum machine learning of Holo-Hilbert spectral frequency mode modulation to simulation data for the result of prediction. First we use Holo-Hilbert algorithm to run over the Chern-Simons current. The result of the Chern-Simons current and FM1, FM2, FM3 over the lattice of graphene wormhole is shown in Fig. 9. We can notice that FM1 are nonstationary time series data. But FM2 and FM3 are more stationary with constant frequency over carbon lattice. It is analogy with coherent states of Cooper pairs sprectrum of constant momentum over carbon lattice k. The layer2 of frequency mode modulation of the Chern-Simons current FM2 is choosen for the prediction of a size of wormhole since FM3 is close to zero and cannot perform further data analysis of PCA. In our model the FM3 is in analogy with the graviphoton frequency so we still pay attention to the study of behavior of spinor network of data analysis of FM3 to the Metropolis-Hastings algorithm and Dirac spinor network algorithm of planar graph to detect their effect to the Chern-Simons manifold. In order to do that, we generate random matrix for the adjacent matrix with fix size of child1, X_t, input spinor network structure with 18×18, see Fig. 10. For the network with 84 carbon atoms the result is separated into small groups of several clusters. It implies that with such network structure the topology of carbon atoms is not coherent and not stable. The result of spinor network for $k = 3$ in FM3, the graviphoton in child1 manifold, is shown in Fig. 11. We found that the network forms two clusters of Cooper pairs over two coherent clusters of carbon atoms in very high symmetry. On the right panel of Fig. 11 we show the average tensor correlation of all three connections, the modified Wilson loop in our new definition of behavior

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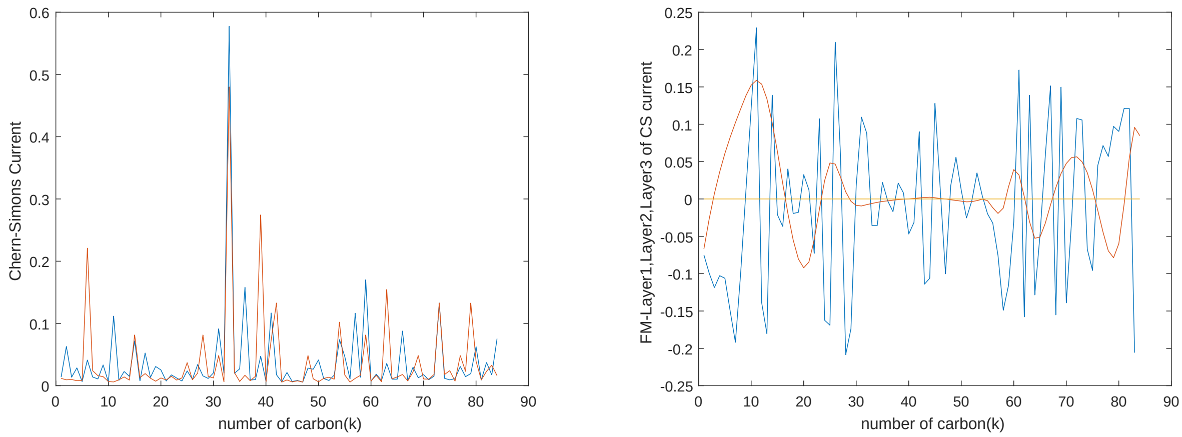

Figure 9. On the left: the picture shows the Chern-Simons current over carbon lattice of graphene wormhole from two simulations of Metropolis-Hastings algorithm plotted together. We randomly choose the Chern-Simons current at least 84 times over the grid of fixed spinor network of carbon lattice with 84 atoms and we compute the correlation matrix with the size 84×84. On the right: the plot of FM1 (blue), FM2 (red) and FM3 (yellow) of the Chern-Simons current over carbon lattice of graphene wormhole from two simulations of Metropolis-Hastings algorithm plotted together.

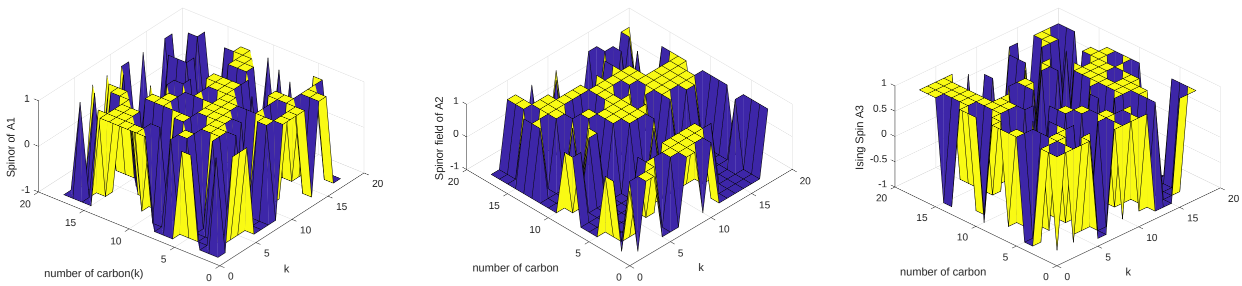

Figure 10. The result of Metropolis-Hastings and Ising algorithm for supersymmetric support spinor fields A_1, A_2, A_3 (from the left to the right) of X_t span by 18×18 carbon lattice. The surface plot shows the result of spinor field.

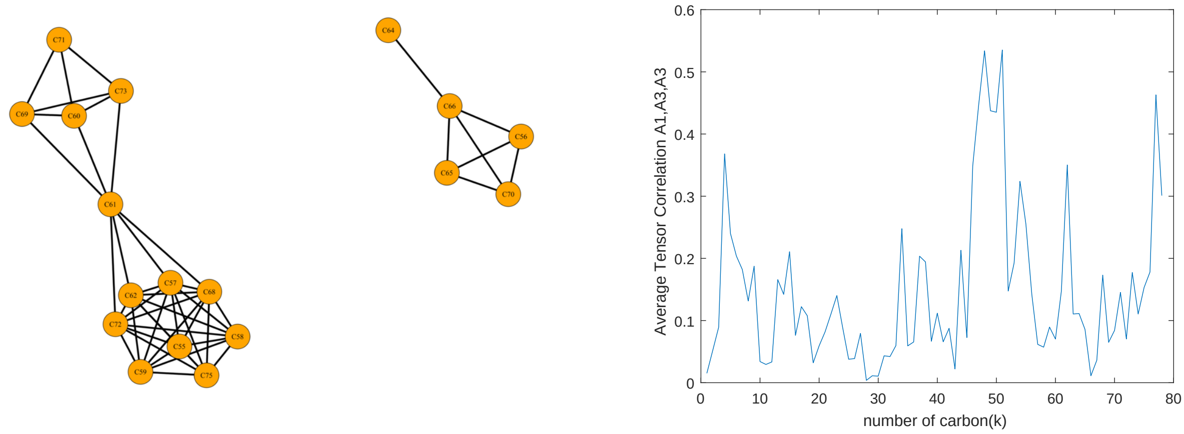

Figure 11. On the left: the Ising alorighm result below T_c for the spinor network in the iteration $k = 3$ of child1 manifold. Above T_c the spinor network will break down and separate. On the right: the average tensor correlation between $A1$, $A2$, $A3$ connections.

of Cooper pairs. The highest point of two Cooper pairs and the graviphoton is coupling approximately at $k = 50$

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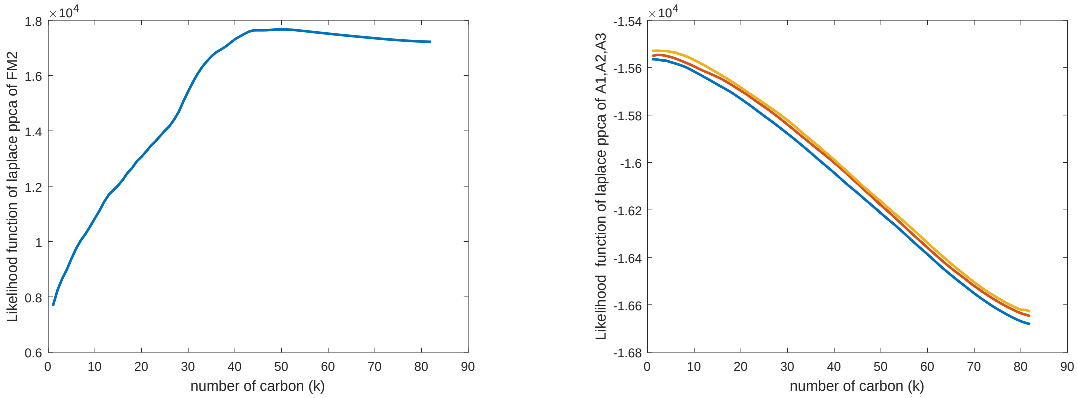

Figure 12. On the left: the plot of maximum likelihood function of Laplace probabilistic PCA of FM1. The maximum probability is at $k = 50$ of carbon lattice atoms. We use this result to calculate the height of wormhole structure in the nanotube. On the right: the plot of Laplace PCA of spinor fields A_1 (red), A_2 (blue), A_3 (yellow), all have only one component of carbon atom.

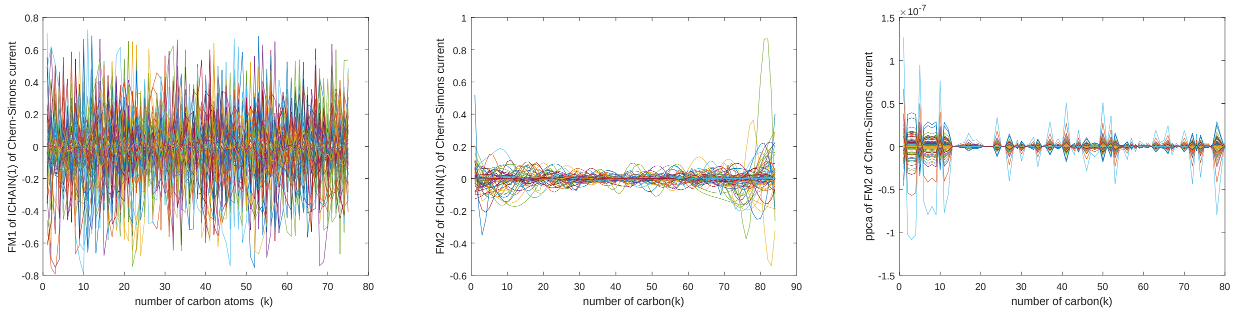

Figure 13. On the left: the plot of layer1 of frequency mode modulation of Holo-Hilbert transform (FM1) of first 75 of 84 carbon lattice atoms for the input to tensor correlation algorithm to find a spinor network. In the middle: the plot of layer2 of frequency mode modulation of Holo-Hilbert transform (FM2). On the right: the plot of PPCA of FM2 of the Chern-Simons current.

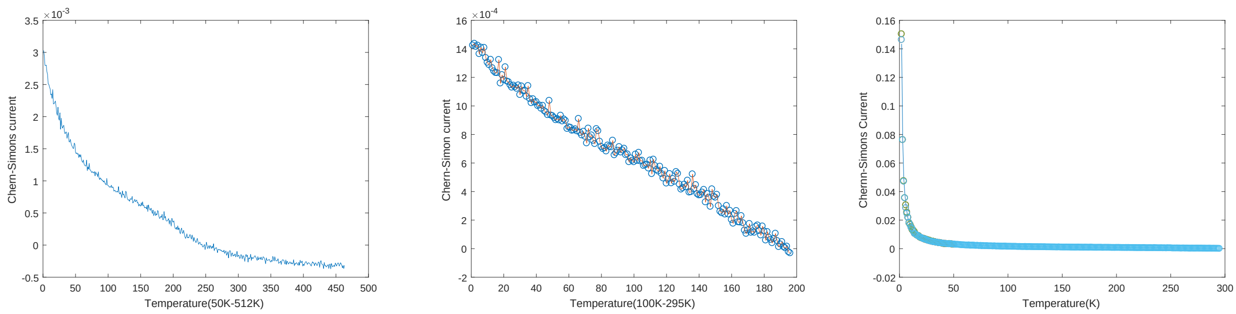

Figure 14. The plot of average Chern-Simons current density over 54×54 lattice of carbon atoms. The numerical simulation is performed with Ising algorithm using the spinor network of A_2 in the temperature range $T = 50\,\mathrm{K}, \ldots, 512\,\mathrm{K}$. It shows the fluctuation of current density at high temperature. In low temperature, there is no fluctuation in the simulations. In the middle panel, the plot of average Chern-Simons current density for the temperature range $T = 100\,\mathrm{K}, \ldots, 295\,\mathrm{K}$. We can not notice the fluctuation in this plot. We need more zoom to data in smaller range to see the nature of current fluctation in high temperature. On the right: the plot of average Chern-Simons current density over 54×54 lattice of carbon atoms. The numerical simulation is performed with Ising algorithm using spinor network of A_1 (red), A_2 (blue), A_3 (yellow) in the temperature range from $T = 1\,\mathrm{K}, \ldots, 295\,\mathrm{K}$.

in highest peak of the plot. This result implies that the stable structure of the Chern-Simons manifold might be at this point. We use Laplace probabilistic PCA [45] to find the right dimension of carbon atoms in the Chern-Simons

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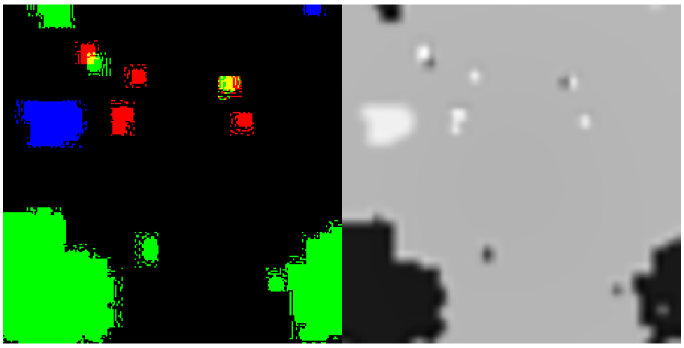
(a) (b) (c)



(d)

Figure 15. The picture at top panel is generated from the Metropolis-Hastings algorithm draw in an adjacent matrix of spinor A_1 (a), A_2 (b), A_3 (c), at temperature $T = 137\,\mathrm{K}$. We glue the pictures into three channels of RGB image (d). On the bottom panel is the picture output in hidden layer after applying convolutional operator. The class of these input data for the prediction of superconductivity state we label with real value 0 for CNN to learn.

bridge. The input for our calculation is the flux quantum of phase shift in the Cooper pairs wavefunction in the form of Holo-Hilbert spectra of FM1, FM2, FM3 and their connection of flux attached to spinor network of carbon lattice by the Ising simulation of supersymmetric Dirac support machine. The result of Laplace PCA is shown in Fig. 12. We found that the size of Chern-Simons bridge is composed of $k = 50$ from the input of Cooper pairs over 84 carbon lattice. From this calculation we get the size of graphene wormhole with the height 1.20867 nm. This value comes from the stack of nanotube with only 12 carbon atoms per one round. We use sp^2 bond length in the graphene approximately with 1.48 Å and we get the value 8×1.48 Å $= 1.20867$ nm. In order to find the spectrum of the Cooper pairs, we use probabilistic PCA so called Gaussian PCA, and applied it to FM2 of Holo-Hilbert transform. We got the result for coherent spectra of Cooper pairs, see the right side of Fig. 13. The results for the prediction of the Chern-Simons current is shown in Fig. 14.

We prepare two groups of sample images for training and testing with CNN. The input layer size is $54 \times 54 \times 1$ and 2D convolutional layer size is 3×18. The dimension of maxpool layer 2×2 is equal to the dimension of output layer 2×2 for two classes of separated phase of superconductivity and normal state. We detect the phase change from the current density images of classification of two classes of input images to CNN for superconductivity phase (Fig. 15) and for normal phase (Fig. 16). For the Chern-Simons current, we found that the temperatures for order parameter to be in superconductivity state is about 137 K. The supercurrent in our simulations still exists at room temperature but with very small value and with high fluctuations. At low temperatures it is very stationary and no fluctuations are indicated from our results. For simulations and analyses over spinor network, we take into account the spectrum of graviphoton, FM3 on Chern-Simons manifold of three carbon atoms, see Fig. 17.

IV. SUMMARY AND CONCLUSIONS

In this paper, we discussed a new model of the Chern-Simons current to find a graviphoton, a coupling boson massless exchange particle with spin 1, to exchange a mirror symmetry between chiral state of left hand supersymmetry of parallel spin of Cooper pairs of electrons in a graphene wormhole to right hand supersymmetry of free electron pairs in superconductor state. The pairs of four particles are coherent and break chiral symmetry down to three coupling states of the Chern-Simons current 3-forms of the orbitals of carbon lattice in the skeleton of carbon atom in graphene

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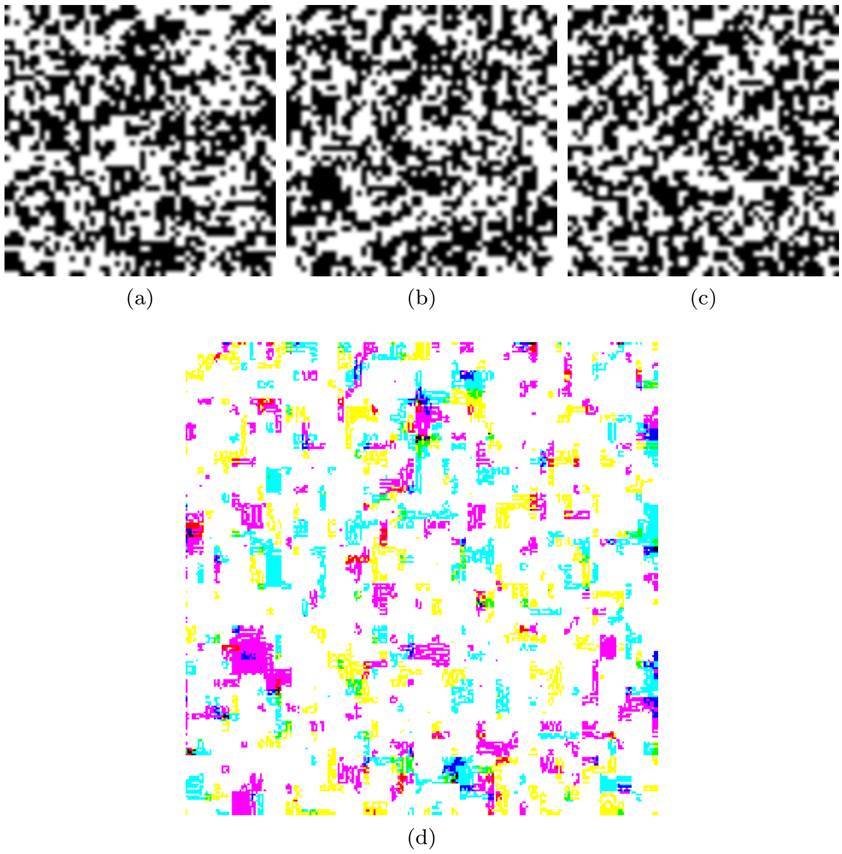

Figure 16. The picture at top panel is generated from the Metropolis-Hastings algorithm draw in an adjacent matrix of spinor A_1 (a), A_2 (b), A_3 (c), at temperature $T = 512\,\mathrm{K}$. We glue three pictures into three channel RGB image (d). The class of these input data for the prediction of normal state we label with value 1.

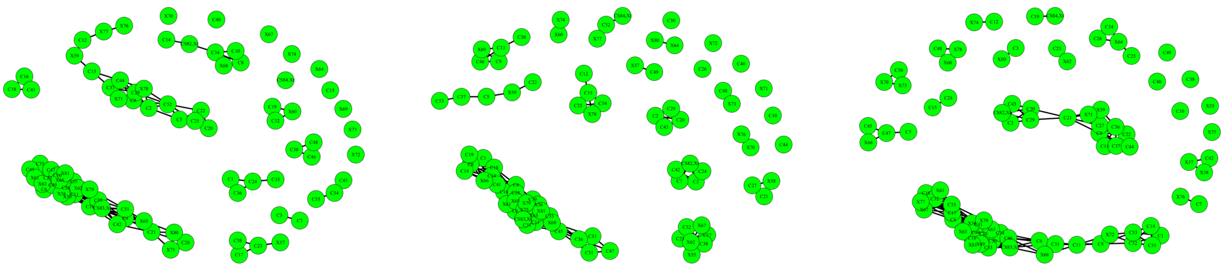

Figure 17. The tensor network of FM3 for the carbons with numbers $k = 82$, $k = 83$ and $k = 84$ (from the left to the right).

superconductor state. We use the model of graphene wormhole to compute the Chern-Simons current in Josephson junction of superconductor states in the graphene. We predict the phase shift between frequency modulation of coupling wave function of Cooper pairs with graviphoton. With this model, we use cohomology of Cooper pairs and applied magnetic flux to build a new model of quantum form as generalization of support spinor network as new circuit for holding memory in entanglement state as new model of quantum supercomputer magnetic resonance device made from graphene wormhole. We implement a new algorithm to compute the current over spin foam network by using holomorphic map of connection over modified Wilson loop. We derive the analogy of hidden energy by frequency modulation in 5th dimensional layer parametrized by dt^*. We develope a new cohomology of behavior of Cooper pairs as Hopf fibration molecular orbital around carbon atom. We use new quantum machine learning so called supersymmetric support Dirac machine to learn and classify the order parameters for superconductor. We have found that the supercurrent is appearing at $137\,\mathrm{K}$. We use Laplace PCA algorithm of the holomony of a modified

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Wilson loop over Holo-Hilbert spectrum frequency modulation to find the size of graphene wormhole. The proposed algorithm is very promising for using the quantum machine learning to design new graphene wormhole materials and to improve the quality of other organic chemical materials. This algorithm is useful to apply image processing and deep learning to structure of a carbon backbone in very complicated organic materials, proteins and all enzyme receptors. In the future we plan to show how to apply the results of this work to learn a protein structure and a structure of enzymes in a metabolism. The new definition of modified Wilson loop fits with the definition of a genetic code for learning the behavior of gene in a receptor of viral protein with lattice structure of amino acides and genetic code.

ACKNOWLEDGMENT

This article is based upon work from CANTATA COST (European Cooperation in Science and Techonology) action CA15117, EU Framework Programme Horizon 2020. SC acknowledges INFN for partial support. The work is partly supported by Scientific Grant Agency VEGA Grant No. 2/0009/19 and No. 2/0153/17. RP would like to thank the TH division in CERN and BLTP in JINR, Dubna for hospitality.

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