Symmetry Principle in Dynamical Conserved Topology

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Abstract: Dynamical conserved topology(DCT) has conserved number of nodes and links' ends, its nodes can exchange with other nodes, its links' ends can transferred from one node to another, and its links can rotate between nodes. Through analyzing their symmetry properties, we can get the detail behavior of DCT, which can be simulated by computer with my program. And by comparing with space with 3 dimensions or 26 dimensions as string theory, we can get its CPT properties, which can be evidence of the theory.

Keywords: DCT, symmetry, exchange, spin, transfer, nodes, links

1 Introduction

Let's begin our topic from a process.

State Name	link Form
Init state	A→←B
Final state	B←→A
Waiting state	B←←B

Table 1.1 Irreversible exchange

⇨←→←→	←⇨→←←	→⇨←→←	→←⇨←→
1	2	3	4

Fig. 1.1 Series irreversible exchange make movement

1. In table 1.1, when events occur, the init state can maintain as origin, or change to final state with possibility. But it is irreversible. So the process is called as irreversible exchange.
2. As figure 1.1: many irreversible exchange pair put together in a series connection, after every exchange, new init state will form, which make the process sustainable. Any exchange pair not in init state need wait their neighbor acting over to form a new init state, which let the process synchronized.

In this article, by analyzing topological symmetry, the equilibrium of movement and symmetry broken, we can get the mathematic reason to form such process critically. And we can do further to explain some physical phenomenon, such as the formation of our space and CPT theorem.

This article's theory can be simulated by computer completely, because every step of the topology evolution has been defined precisely and clearly, make it easy to prove by computer or simply drawing.

2 Dynamical conserved topology (DCT)

2.1 DCT and its function

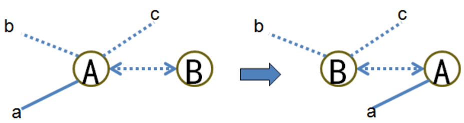


Fig. 2.1 Movements in DCT

As figure 2.1, node A exchange with node B, which will cause a problem, can links' ends go after nodes exchange such as link a?

Definition 2.1: The links in figure 2.1 between two nodes which do exchange or other action called act-links. Other links called cooperative-links. We can't say cooperative-links don't have affect, because they can go after nodes, and they can become act links too in condition.

There are two extreme cases:

1. All cooperative-links' ends stay at the original position, and the topology change maximum, as figure 2.2.
2. All cooperative-links' ends go after relate nodes, and the topology change minimum, as figure 2.3.

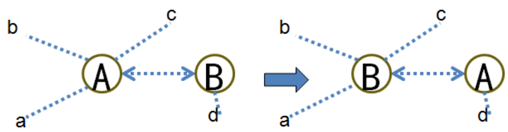


Fig.2.2 Exchange with maximum change

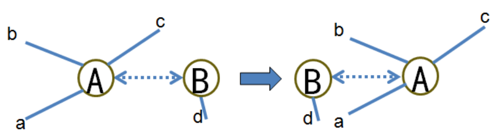


Fig. 2.3 Exchange with minimum change

Definition 2.2: In the upper processes, the total number of nodes and the number of links' ends are invariable, so we call them as dynamical conserved topology (DCT).

It is not hard to find the relationship: links ends go after (F) + nodes exchange (E) = transfer of links' ends (T) + act-links rotate (R). By this equation, we can express any kinds of action with the other three. For F is too complex, so let's begin with E, T and R. When DCT is stable, they should be in equilibrium.

We should notice that nodes are moveable only by exchanging in DCT, which means single node can't move, otherwise relate links will lose their ends which should be conserved. And a link is nonsense if it can only rotate and just go after, so links in this article at least can transfer other links' ends or exchange nodes when in action, but actions can stop in specific condition.

2.2 Symmetry effect to DCT

The factor which affect to the action must be the ones take part in it, so we have:

- ✧ Factor to links spin: act-links and relate nodes. Can be simplify to symmetrical characteristic of the relationship between act-links and relate nodes from act-links' view.
- ✧ Factor to nodes exchange: act-links and relate nodes. Can be simplify to symmetrical characteristic of the relationship between act-links and relate nodes from nodes' view.
- ✧ Factor to transfer of links' ends: act-links, relate nodes, and the ends. Many transfer acts may cause other links rotate, too, but it is different from spin. Can be simplify to symmetrical characteristic of the relationship between the cooperative-links ends and relate nodes, the same to act-links.

Let us begin symmetry discussion from the view of cooperative-links by default if not mention. For any asymmetry of an independent property can be express to its symmetry superposition with its anti-symmetry. So we should only talk about symmetry and anti-symmetry situation.

1. As figure 2.4, if act-links' ends are the same, and the two nodes are the same, after transfer, the connection form have not changed, so the transfer is reversible. And no matter whether the transfer is feasible or not, average drift of ends is 0 in equilibrium state (can cause diffusion).

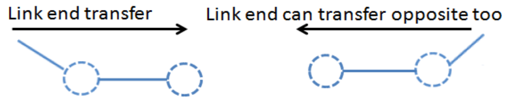


Fig. 2.4 Reversible transfer through symmetry act-links and nodes

2. If the two sides of act-link are asymmetry which should have sense to cooperative-links, then the average drift must not be 0. Let's discuss act-links anti-symmetrical and nodes symmetrical situation first.

A. As figure 2.5, if the act-links have spin, because the connection form is the same before and after rotate, so transfer of cooperative-links' ends is reversible, average drift is 0. Name these act-links with spin as pseudosymmetrical vectorial links.

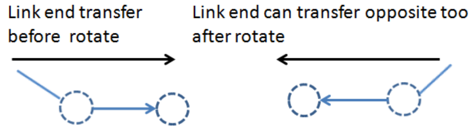


Fig. 2.5 Reversible transfer through symmetry nodes and act-links with spin

B. If the act-links have no spin, then the transfer of cooperative-links' end is irreversible, called first kind of irreversible phenomenon (FIP). We call these act-links vectorial links. There will be two kinds of cooperative-links' end stay at each side finally.

3. If the two nodes are anti-symmetrical, and the act-link is symmetrical not only from the cooperative-links' view but also from nodes' view.

A. As figure 2.6, if the act-link can exchange the two nodes, for the connection form is the same before and after exchange, so the exchange is reversible, the average effect is 0. The two nodes are pseudosymmetrical. So the transfer of cooperative-links' end is reversible and the average drift should be 0.

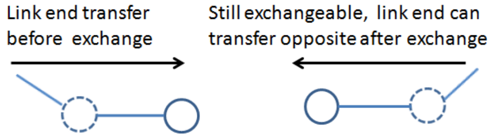


Fig.2.6 Reversible transfer and exchange with symmetry act-links

B. If the act-links can't exchange the two nodes, then the transfer of cooperative-links' end is irreversible, called second kind of irreversible phenomenon (SIP). We call these act-links vectorial links. There will be new two kinds of cooperative-links' end stay at each side finally, too.

4. If the two nodes are anti-symmetrical from links view, and from the nodes' view the act-link is asymmetrical. Then the act-link can cause irreversible exchange of the two nodes. Let us discuss exchange phenomenon first.

A. If the act-link has spin, then it can be regards symmetrical and have the same situation as 3.A.

B. If the act-link has no spin, then the exchange is irreversible, called third kind of irreversible phenomenon (TIP). There will exit two mode called init mode for temp, and final mode. As figure 2.7.

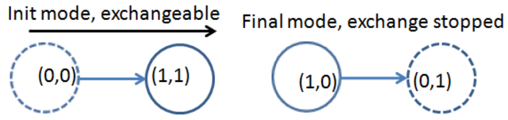


Fig. 2.7 Irreversible exchange with anti-symmetry act-links and nodes

By this situation, we can divide cooperate-links ends to 4 kinds to make the problem easy.

Definition 3.1: If the cooperate links' ends go after relate nodes in both modes, then call them nodewards ends. Else ends called vectorwards ends which relate to the act links.

Vector followed ends is very important, if we put act-links in a series connection with the same act direction, they will go to the boundary without stop, which will make great effect to the boundary. If there is a kind of link with 2 kinds of vectorwards ends, then it can help to link from the start node to the end node which will make DCT unstopped and form a loop.

There are also links can mix vectorwards ends and nodewards ends together.

The division can be also used to situation in symmetry act-links, because any symmetry act-links can be resolved into 2 anti-symmetry act-links with opposite act direction.

In final mode the exchange will define 2 kinds of nodes, and exchange direction of act-links. If in final mode, a node is at positive exchange direction, then it is positive, else it is negative.

5. Now let's talk about its spin. We can divide spin to two kinds, stoppable and unstoppable. We do not need talk about symmetry act-links from the nodes view, because they are reversible.

A. If spin is unstoppable, means spin have no relation with nodes, its act will be reversible.

B. If spin is stoppable called fourth kind of irreversible phenomenon (FIP), then in act-links' view, the nodes should be asymmetrical. After spin stop, we can define a direction by node type relate to spin, called node direction, which can be same as exchange direction or different to exchange action. And we can divide node to 4 kinds, as table 2.1. Relate nodewards ends can be divided into 4 kinds, too.

H represents head node from the view of act-links defined by spin, T represents tail node. Solid circle represents positive node defined by exchange action, and dashed circle represents negative ones.

Figure				
Name	Positive head node (PHN)	Negative head node (NHN)	positive tail node (PTN)	negative tail node (NTN)

Table 2.1 Nodes classification

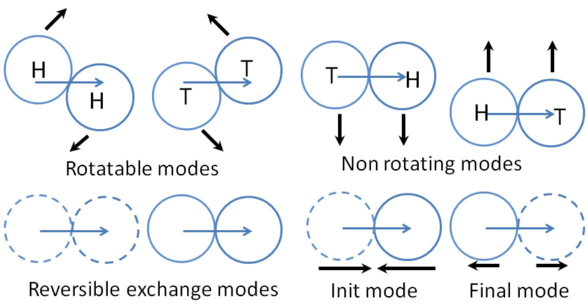


Figure 2.8 Different between rotation and exchange

Spin will cause nodes rotation, which is very different from exchange. From figure 2.8 we can clearly see the different between rotation and exchange, rotation have 2 stopped modes when their 'H','T' value are different. But exchange only have 1 stopped mode as final mode. Consider irreversible exchange, an act-link with spin and exchange have 2 final states, as figure 2.9.

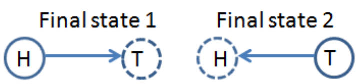


Fig. 2.9 An act-link with spin and exchange have 2 final states

3 Vectorwards links

3.1 Introduce

Definition 3.1: If both ends of a link are vectorwards, then it is a vectorwards link. We can divide them to 4 kinds, as table 3.1.

The arrow direction is exchange direction. If an end has ⊗, then it will go after arrow tail, else arrow head, called as wards direction of the end.

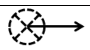
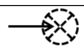
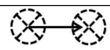
Figure				
Name	consistent vectorwards links(CVL)	inconsistent vectorwards links (IVL)	Positive vectorwards links (PVL)	Negative vectorwards links (NVL)

Table 3.1 Vectorwards links

Definition 3.2: A cluster is all of the ends which at the same node.

3.2 Long run states of vectorwards links

Definition 3.3: If an end exchange direction is the same as its wards direction, then it is a consistent ends. Else is inconsistent.

It is obvious that same consistent ends prefer stay at same cluster, but different consistent ends prefer stay at different cluster. And same inconsistent ones prefer stay at different cluster, but different inconsistent ones prefer stay at the same cluster. Because of these properties:

1. For CVLs, both ends are consistent, so the long run state of them would towards as figure 3.1. They would prefer stay at a small number of clusters, and can't spread too long under strong attractive force.

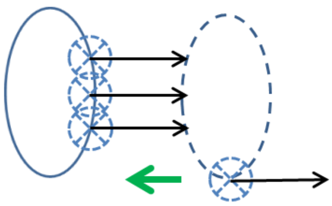


Fig. 3.1 Long run state of CVLs

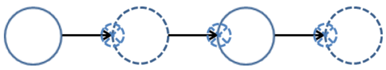


Fig. 3.2 Long run state of IVLs

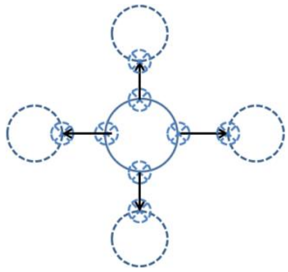


Fig. 3.3 Long run state of NVLs

2. For IVLs, they would prefer spread and form a chain as figure 3.2. But those chains may break. We can use vectorwards links as section 3.3 to connect them.
3. For PVLs or NVLs, they would prefer form networks of centers as figure 3.3.

From above, we know IVLs will domain most region of DCT. When will consider macro region without strong force, we need only consider IVLs. You can see simulation result at appendix.

3.3 Symmetry broken among vectorwards links

Both two ends of a vectorwards link can be put at the same node by other act-links', called this phenomenon as self connection.

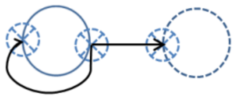


Fig. 3.4 Symmetry broken caused by self connection

As figure 3.4, PVLs and NVLs can connect to themselves under other act-links action, which is hard to spread again. And for IVLs can't get together as CVLs, so CVLs action will be stronger. When consider small region with strong force we must consider CVLs.

Both ends of an IVL can go after each other, so some IVLs can connect to same nodes too when they do acts, but it will cause connection break, make them cannot do other acts and nonsense. So when we talk about IVLs, we refer to those which cannot connect to same nodes by themselves acts.

4 Nodewards links

Definition 4.1: If both ends of a link are nodewards, then it is a nodewards link.

We can divide them to 4 kinds according to their nodewards properties which have final state, but if consider their transfer direction to vectorwards links, there will be 8 kinds as table 4.1. And relate vectorwards links should be 8 kinds, too.

The arrow defines the node direction from tail node to head node. If an end has dot points, it will go after positive nodes; else it will go after negative nodes. Previous 4 kinds transfer from down to up, others transfer from down to up.

Figure								
Symbol	☴	☳	☰	☷	☵	☲	☱	☶
name	b↑	b↓	g↑	g↓	r↑	r↓	w↑	w↓

Table 4.1 Irreversible Nodewards links (INL)

1. In table 4.1 we haven't consider following 6 kinds situation because they are reversible, as figure 4.1.

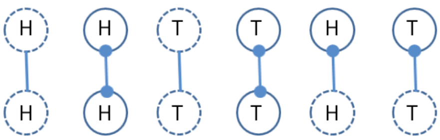


Fig 4.1 Reversible nodewards link

It is because when nodes exchange, nodewards ends will go after relate nodes, which neutralize exchange acts. So we can say nodewards links can't do exchange. But they still have spin, and for nodes do not go after ends, they just can exchange, so nodewards links' spin cannot be neutralized. Their spin will cause reversible effects. If we want them stopped, relate 2 nodes should have different tail and head value.

2. If too many nodewards links stay at a same node, they will diffuse to same kind of nodes and keep balance caused by symmetry action. INLs can't do exchange or rotate because their ends should fixed at specific kinds of nodes, so they must to transfer

vectorwards ends to make sense, which can define a new direction for their relationship. Their transfer acts make vectorwards ends fixed at specific nodewards link direction in anti-symmetry situation.

Definition 4.2: Nodewards links can form small static structure with node which can be linked to other ones by vectorwards links or mix type of links, called them nodewards net.

Figure 4.2 shows the interaction among different nodewards nets by CVLs. The simplest nodewards nets are only make up 2 nodes and one kind of nodewards links such as net C, call them as nodes pair.

And because the movement in a net is not freely for head-tail symmetry, we find that interaction between different nets can be resolved to interaction among nodes pairs. To draw the figure for interactional nodes pairs, we should notice:

1. For vectorwards links between head nodes, or tail nodes have spin, so the transfer effect will be 0 averagely.
2. For vectorwards links between positive nodes, or negative nodes exchange acts are reversible, so the transfer effect will be 0 averagely, too.

Figure 4.3 shows some irreversible exchange process between nodes pairs which means they can transfer vectorwards ends irreversibly or move forward by exchange (the vectorwards links arrow direction is drawn as node direction). We can connect them in series by IVLs to make the transfer continuously like figure 4.4, which have the same structure as figure 1.1 with init state and final state take place by turn. Call this series as a chain. A chain often forms a loop. And the final mode direction defines the chains' direction.

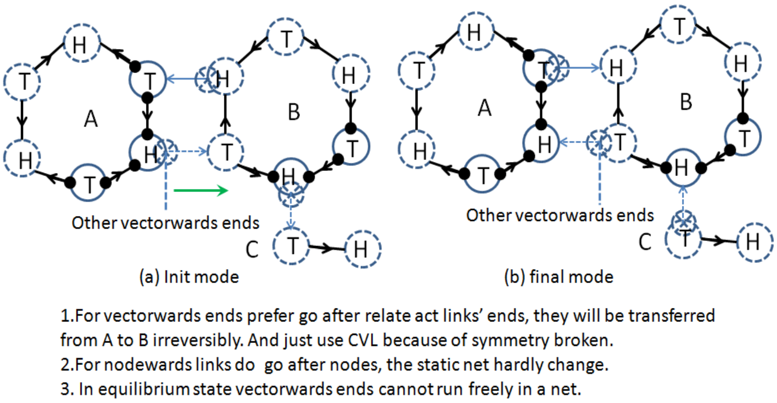


Fig. 4.2 Interaction between nets through CVLs

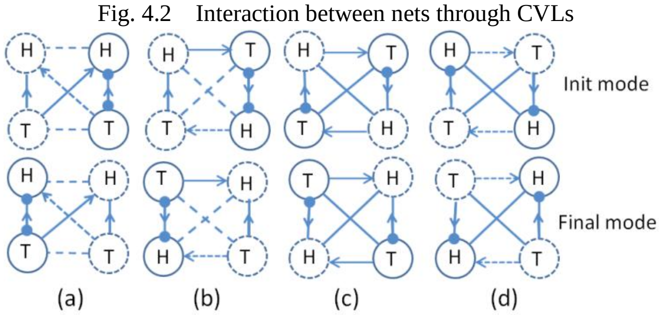


Fig. 4.3 Irreversible exchange between node pairs through IVLs

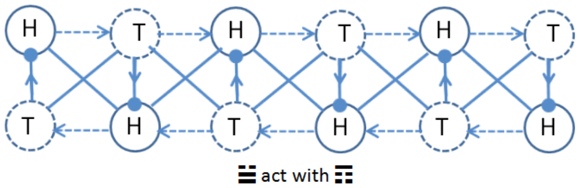


Fig. 4.4 A series irreversible exchange between node pairs make movement through IVLs

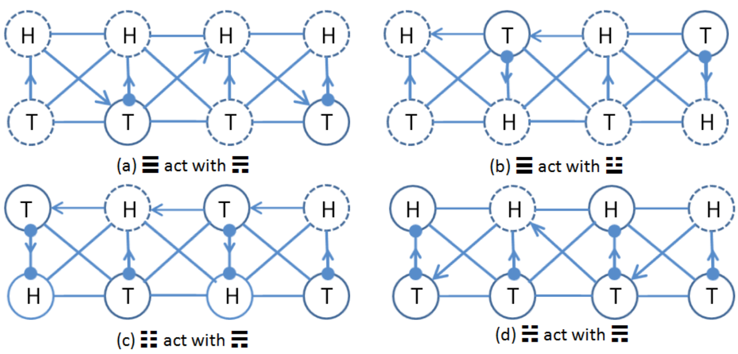


Fig. 4.5 Half irreversible exchange through IVLs

Besides completely irreversible and reversible exchange, there exist only one node can do irreversible exchange situation, like figure 4.5, called them as half irreversible exchange (HIE). Because in HIE only one end of nodewards links can move, the other end will fixed in position and share its nodes, and a chain is often a loop, so they can drawn as rotation as figure 4.6 which requires fewer nodes in fixed position.

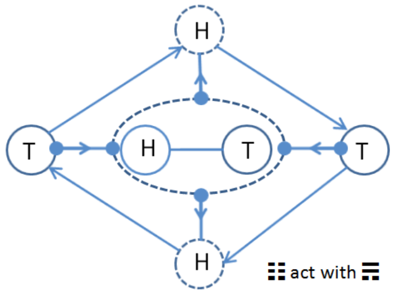


Fig. 4.6 Half irreversible exchange through IVLs as rotation

Table 4.2 gives the exchange properties between different node pairs. If both nodes exchange completely irreversible denote as 1, else if reversible denote as 0, and denote as 1/2 if half irreversible.

Type	☴	☳	☰	☷	☵	☲	☱	☶
☴	1	1	1/2	1/2	1/2	1/2	0	0
☳	1	1	1/2	1/2	1/2	1/2	0	0
☰	1/2	1/2	0	1	1	0	1/2	1/2
☷	1/2	1/2	1	0	0	1	1/2	1/2
☵	1/2	1/2	1	0	0	1	1/2	1/2
☲	1/2	1/2	0	1	1	0	1/2	1/2
☱	0	0	1/2	1/2	1/2	1/2	1	1
☶	0	0	1/2	1/2	1/2	1/2	1	1

Table 4.2 Link methods between node pairs

5 Mixwards links and some simulation results

Definition 5.1: A link is Mixwards if one end of a link is nodewards, the other end is vectorwards.

I would prefer to use computer to simulation their movement, so I won't talk too much about them in this article. I haven't added them to my program yet. Without consider mixwards links, we can get the simulation result after long run as Figure 5.1,5.2 (I have not added anti-symmetry transfer properties to nodewards links yet in my program, just let them do diffusion):

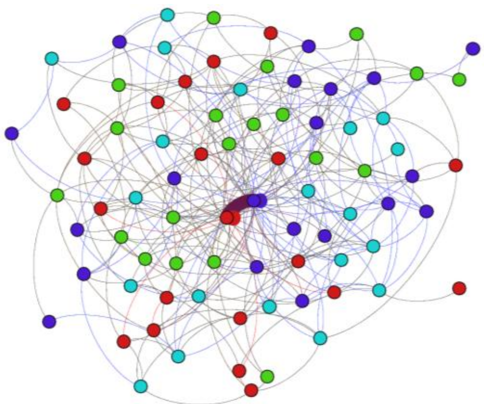


Figure 5.1 Distribution of all links

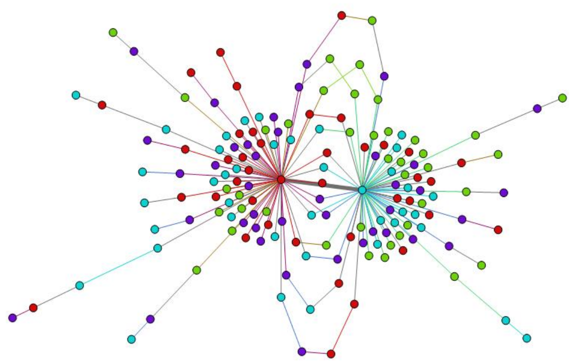


Figure 5.2 Distribution of vectorwards links like electric field

The center can have different shapes such as triangle or pyramid. You can download my program at:

http://pan.baidu.com/share/link?shareid=356910012&uk=973245268.

Generally we can divide links according to their acts or their wards properties. By their act we can divide them according to their exchange acts, transfer acts and rotation acts. By wards property we can divide according to whether their ends are nodewards or vectorwards.

6 The dimension of DCT

6.1 Directions from macroscopic view

I wouldn't prefer to talk about this forum, because it is hard to say DCT has dimensions like space-time, for they are different in fact. But I believe that our space is a DCT, in macroscopic view they are the same.

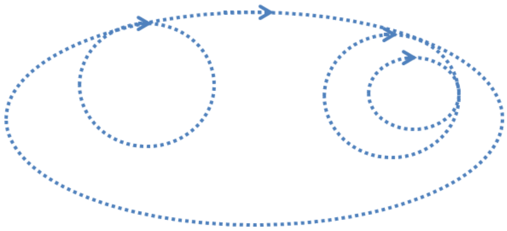


Fig. 6.1 Many chains cross together

In a complex DCT, a nodewards link can form many same kinds of chain with many relate nodewards. So the first problem we should resolve is which loops determine their movement direction in macroscopic view, as figure 6.1.

- ✧ Because those little loops share the property of exchange action, which make the speed slow down in the big loop with synchronization. And the speed in the overlapping segment will be faster.
- ✧ The long run trend is determined by big loop.

If an overlapping segment has $n-1$ little loops, whose lengths are l_i. So the possibility of nodewards links pass the overlapping segment through big loop is $1/n$ per time. Then the possibility of a nodewards links passes the overlapping segment at k th time is:

$$p(k) = \frac{(n-1)^{k-1}}{n^k} \qquad (6.1)$$

So the average length a nodewards passes through is:

$$\bar{L} = E(\mathrm{k}) \times \bar{l} = n\bar{l} = \sum_{i}^{n-1} l_i = L_{total} \qquad (6.2)$$

It is exactly equal to the total length of those small loops. So we can regard those loops as one big loop in macroscopic view which reflects a dimension but speed slow down.

If chain direction is movement direction, everywhere and every direction have nodewards links, can a nodewards links form same kinds of chains with others in every direction, if it can, how can we move? This is second problem which confused me for a long time but easy.

- ✧ First, Because nodewards links are separated in nodewards net, and for vectorwards links can't move very freely in the net at equilibrium state, so they have to use independent vectorwards links, which form chains parallel to each other, as AB and AC in figure 6.2. So even if 2 nodewards links are very near, they can't exchange with each other.
- ✧ Second, from macro view, we would prefer use IVLs to form space and time, because other kinds of vectorwards links prefer at a point region. For same kinds of inconsistent end repel each other, IVLs number between different nodes are very small, which will limit the possible direction choices.

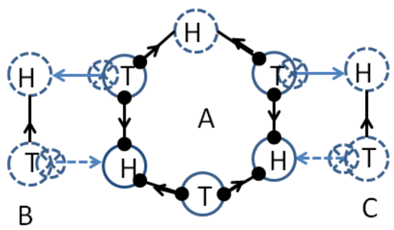


Fig. 6.2 Same kinds of irreversible exchange in same net

6.2 To form our space

It is interesting that there are 26 kinds of irreversible or half irreversible chains in table 4.2 which is exactly as string theory required [1]. Now let us construct space with 3 dimensions.

- ✧ The first kinds of chains we can ignore are reversible ones with value equal 0 in table 4.2.
- ✧ The second kinds of chains we can ignore are chains in diagonal of table 4.2, which are exchange between same kinds of nodewards links, there are few different between and after from other links view.
- ✧ The third kinds of chains we can ignore are half irreversible chains, because their act can cancel each other caused by symmetry. I won't talk about this at this article, you can refer to figure 4.5, and consider relate nodewards links exchanged by their completely irreversible partner or reversible partner, then the nodes will be pulled back by its partner.
- ✧ For both ☰ and ☲ can do irreversible exchange with ☷ and ☵, but can't do irreversible exchange with themselves as table 4.2, those 2 two dimension will mix to 1 dimension with the same average movement direction. As figure 6.3

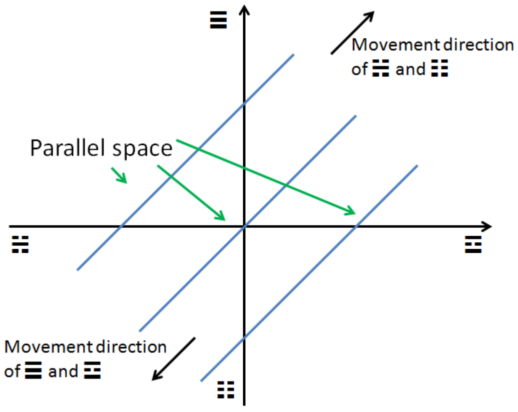


Fig. 6.3 ☰ and ☲, ☷ and ☵ mix to 1 dimension and form parallel space

Finally, we get a 3-dimensions movement space. They are:

Coordinate axis	x	y	z
Symbol	☴ ⇔ ☳	☱ ⇔ ☶	☰ + ☲ ⇔ ☷ + ☵

Table 6.1 Irreversible exchange in space dimensions

Figure 6.3 suggest that there are many universe parallel to each other.

7 CPT theorem for nodewards links

(1) Parity: inversion of space, according to figure 6.3 and table 6.1, we can get:

Inversion of space			
☴ ⇌ ☳	☰⇌ ☵	☲ ⇌ ☷	☱ ⇌ ☶

Table 7.1 Inversion of space

In table 7.1 ☰⇌ ☵ and ☲ ⇌ ☷, it is because the movement should be in space, mean the inversion should parallel to axis z.

(2) Time reverse: it is most simple, just change nodewards links to its opposite partner, which will make all action reversed:

Time reverse			
☴ ⇌ ☳	☰ ⇌ ☷	☲ ⇌ ☵	☱ ⇌ ☶

Table 7.2 Time reverse

(3) Charge conjugation: to make CPT conserved, we should do transformation as table 7.3. It reverse the axis which perpendicular to movement space.

Charge conjugation	
☰ ⇌ ☲	☷ ⇌ ☵

Table 7.3 Charge conjugation

(4) CPT theorem: let us do P, T and C transformation by order:

CPT	
☴ $\xrightarrow{P}$ ☳ $\xrightarrow{T}$ ☴ $\xrightarrow{C}$ ☴	☳ $\xrightarrow{P}$ ☴ $\xrightarrow{T}$ ☳ $\xrightarrow{C}$ ☳
☰ $\xrightarrow{P}$ ☵ $\xrightarrow{T}$ ☲ $\xrightarrow{C}$ ☰	☷ $\xrightarrow{P}$ ☲ $\xrightarrow{T}$ ☵ $\xrightarrow{C}$ ☷
☲ $\xrightarrow{P}$ ☰ $\xrightarrow{T}$ ☷ $\xrightarrow{C}$ ☲	☵ $\xrightarrow{P}$ ☰ $\xrightarrow{T}$ ☷ $\xrightarrow{C}$ ☵
☱ $\xrightarrow{P}$ ☶ $\xrightarrow{T}$ ☱ $\xrightarrow{C}$ ☱	☶ $\xrightarrow{P}$ ☱ $\xrightarrow{T}$ ☶ $\xrightarrow{C}$ ☶

Table 7.4 CPT transformation

In table 7.4, left nodewards links equals right nodewards links, which means after CPT transformation nodewards links keep the same.

Summary

In this article, we introduce DCT, in which nodes can exchange with each other, links can move and rotate. And get the law of their movements by analyzing its symmetry properties. We compared it with space, find them are very similar, in dimension properties and CPT theorem. And by write a program we give evidence of this theory.

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References

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