Comparison of particle model based on virtual spacetime and quark model and the discussion of charged Higgs bosons

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Abstract

This paper explores why the particle model based on virtual spacetime is consistent with the results of the quark model. The biggest problem with the quark model is why the quark has a fractional charge, but it cannot be detected. From the condition of the Dirac charge quantization, the fractional charge does not satisfy the charge quantization condition, so it is impossible to observe it in real spacetime. Otherwise we will be able to detect the magnetic monopole. However, quark's fractional charge constructs different baryon structures and is supported by strong experimental evidence. This shows that the quark's fractional charge is reasonable. At least there is strong indirect support. Therefore, any newly created particle model should at least have a quark model as a subset. It can be seen from the analysis of this paper that the virtual spacetime particle model contains the quark model and can predict the all predicted results of quark models. But the virtual spacetime particle model has a larger range and can predict new particles that the quark model cannot predict. By analyzing the meson model in the virtual spacetime particle model, we find that in addition to the currently discovered Higgs boson, there are two Higgs bosons with positive and negative charges in nature. The Bosons are positive and negative particles, and their energy range is at the range of 110~140GeV, which should be found on LHC and other colliders.

Key words

Quark model; Virtual spacetime; Virtual spacetime physics; Higgs boson

1 Introduction

The quark model has achieved great success in particle physics [5, 6], although some assumptions have strong subjectivity and have not been directly confirmed by experiments. But as a theory that predicts new particles, it is very valuable to achieve these successes in a very high-energy region and difficult to experiment with.

However, the quark in the quark model has a fractional charge, and such a hypothesis does have many things to discuss. After all, the theory has been proposed for more than fifty years, and there is no direct evidence in the laboratory of the existence of fractional charges. Another problem is that the fractional charge is contradictory to the Dirac charge quantization condition. If fractional charge is present, there should also be cases where fractional charge quantization occurs. However, the quark model cannot give the same results as the Dirac charge quantization conditions [7]. Although the existence of magnetic monopoles is required in Dirac charge quantization conditions, although magnetic monopoles have not been found experimentally, after introducing virtual spacetime, magnetic monopoles are like electric charges in virtual spacetime. Such magnetic monopoles have a higher degree of symmetry with the charge in the real spacetime. Therefore, the result of charge quantization should be integer rather than fractional. Unless we can determine a new mechanism in the future, we can guarantee that the integer charge is divided into three parts. At present, there are no theoretical or experimental signs.

2 Particle model based on virtual spacetime

The particle model based on virtual spacetime is very simple [1~4], it first assumes that all the elementary particles are only leptons and proton. Thus, the elementary particles in real spacetime include six types of leptons and one proton and their anti-particles.

The six types of leptons are electron, electron neutrino, muon, muon neutrino, tauon, tauon neutrino, and their antiparticles.

The proton is the only baryon in the elementary particles.

Electron, μ, τ, and proton are all charged. The three neutrinos are uncharged. This is consistent with Dirac's charge quantization conditions.

All elementary particles are the same and are all simple spherical structures. The charged lepton is the same as the corresponding neutrino radius.

For charged particles, according to the conclusion of physics of virtual spacetime [1], the surface rotation speed caused by spin exceeds the speed of light, which makes the radius of electron and muon in the virtual spacetime, so it is impossible to detect in real spacetime. The surface rotation speed of the tauon and proton due to spin is less than the speed of light, which means that the radius of the tauon and proton can be detected in real spacetime.

Since the radii of proton and tauon can be measured in real spacetime, the other leptons radii are in virtual spacetime and cannot be measured. In addition, all the leptons have a smaller radius than the proton, so the leptons can enter the proton, the tauon and the like to form more other composite particles.

2 Particle model based on virtual spacetime can automatically meet the conservation condition

For the quark model, several important conservation laws must be specified. They are conservation of baryon numbers, conservation of lepton number, conservation of isospin, and conservation of charge.

It is easy to prove that the particle model based on virtual spacetime can automatically satisfy all the conservation conditions.

First, the composite particles in the particle model based on the virtual spacetime can use the decayed products to form the corresponding particle structure.

For example, if there is a baryon A decays into a baryon B and two opposite leptons, it can be expressed as

$$A = B + a + \bar{a} \qquad (1)$$

Uppercase letters indicate baryons and lowercase letters indicate lepton. The underlined letters indicate antiparticles.

Then based on the particle model of the virtual spacetime, it can be concluded that the structure of the A particle consists of the B particle containing two lepton a and $\bar{a}$.

However, since A is only a particle, the charge of lepton a must be redistributed to the surface of the A particle.

The reason why there must be two opposite leptons is because the energy of the virtual spacetime corresponding to the magnetic monopole must be eliminated. Otherwise the resulting composite particles will get many times more energy than the base particle B.

The formed composite particles can be represented by the particle decay diagram [1, 3] shown in Fig 1.

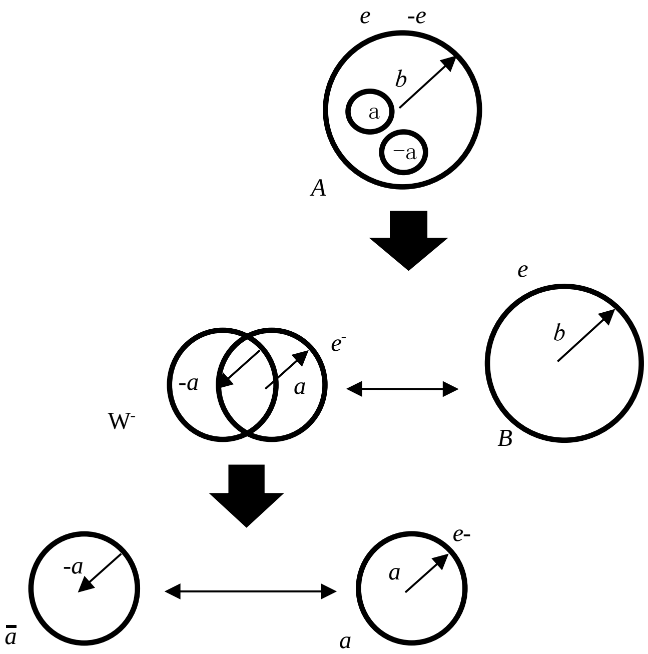

Fig. 1. The decay diagram of composite particles

In the reaction process of these composite particle, what is the result of the decay, which particles will be contained in the internal structure of the composite particle. It is only the charge that needs to be redistributed on the surface of the particle and the addition and subtraction of the charge of the particle, which naturally guarantees the basic requirements of charge conservation.

The energy forming the composite particle *A* should not contain the energy of the lepton in the virtual spacetime, otherwise the super-energy particle will be formed. For example, if there is only one electron inside the proton, the total energy crossed the virtual and real spacetime of the composite particle formed will exceed twice the proton. It will also destroy the symmetry of particles in real spacetime and virtual spacetime particles.

This symmetry damage can be analyzed in this way.

Each particle is composed of two parts of virtual spacetime and real spacetime [1,4]. For example, the real spacetime energy of electrons is an electric field, and the virtual spacetime energy is a corresponding electro-magnetic monopole magnetic field. The real spacetime energy of a proton is the electric field of a proton, and the virtual spacetime energy of a proton is the corresponding proton-magnetic monopole magnetic field.

If only one electron enters the proton inside the real spacetime, the real spacetime composite particle will contain the proton electric field and the electronic electric field, and the virtual spacetime will contain the proton-magnetic monopole and the electro-magnetic monopole magnetic field.

Now from the perspective of virtual spacetime, since the proton-magnetic monopole energy is equal to the electron electric field energy, the electro-magnetic monopole energy is equal to the proton electric field energy. From the point of view of symmetry, the proton-magnetic monopole is the electron of the virtual spacetime, and the electro-magnetic monopole is the proton of the virtual spacetime.

It can be found that the proton-magnetic monopole of the virtual spacetime enters the electro-magnetic monopole and will also form a composite particle. The composite particles correspond to protons and electrons in real spacetime.

That is to say, if only electrons enter the interior of the proton to form a composite particle, a composite particle of exactly the same will be formed in the virtual and real spacetime. That is, the composite particle will span both time and space. Or the particle can be measured either in real spacetime or in virtual spacetime. This may be a new kind of particle that may exist, such as the Majorana particle [8]. But at the moment, I don't know what methods to detect. Therefore, the existence of such a particle structure can be considered to mean that the virtual and real spacetime is a whole. Because only one overall spacetime will appear only one kind of particle, and there is no case of symmetric particles. This is the same as using the plural form of an imaginary number. It is impossible to include the existence of a number that is both a real number and an imaginary number in a complex number.

Therefore, in order to avoid such a situation, two positive and negative leptons are required to form the internal structure of the composite particles. Therefore, in the virtual spacetime particle model, there is no need to make additional conventions such as the number of baryons and the conservation of lepton.

The analysis of charge conservation and isospin conservation is simpler. Considering that all particles after decay have been included in the composite particles, and in the composite particles, the charge and isospin of these particles are not "deleted", so the charge and isospin before and after decay of the composite particles are conserved.

3 The particle model based on virtual spacetime can predict all of the baryons and mesons which predicted by quark models

This is also easy to understand. Because as long as it can be confirmed that there is some kind of baryon decay process. Using the particle-modeling method of virtual spacetime, the lepton in the decay product is directly put into the baryon, and then the charge of the lepton is redistributed on the surface of the baryon to form a composite particle. Therefore, theoretically all the baryons predicted by the quark model can be incorporated into the particle model based on the virtual spacetime. However, in defining the concept of composite particles, in the particle model based on virtual spacetime, protons are stable basic particles, which can no longer be segmented and will not decay again.

The relationship between the quark model and the virtual spacetime particle model can be represented by Fig. 2.

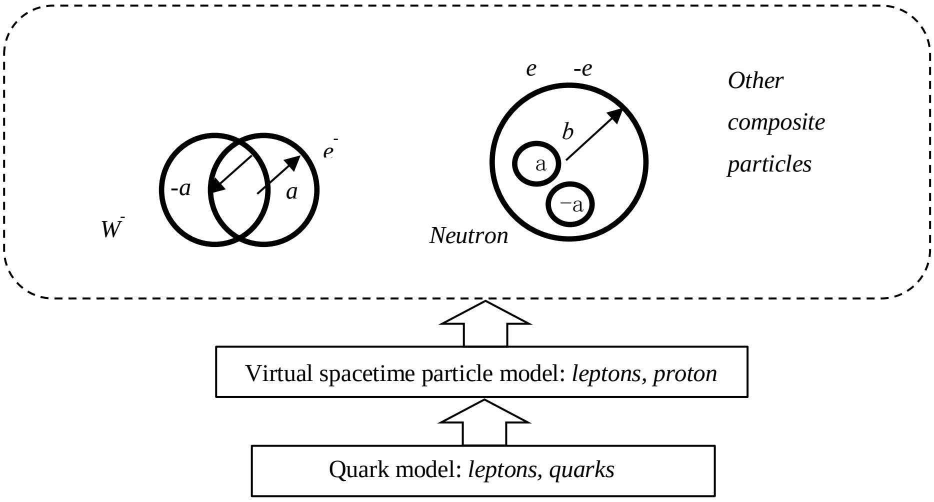

Fig. 2 Relationship between quark model and virtual spacetime particle model

It can be seen from Fig. 2 that the quark model is located at the bottom of the virtual spacetime model, and the virtual spacetime particle model can be constructed from the quark model. The virtual spacetime particle model directly combines all the decayed particle products, and the various particle parameters contained are completely consistent with all the particle parameters after decay. Therefore, from a logical point of view, it is no problem to obtain the final decay result directly from the virtual spacetime particle model.

However, the question is whether the quark model can be constructed from the virtual spacetime particle model. As shown in Fig. 3. If the quark model can be constructed from the virtual spacetime model, it means that the two models are completely equivalent. If not, it means that the virtual spacetime particle model covers a larger range than the quark model. I prefer the latter.

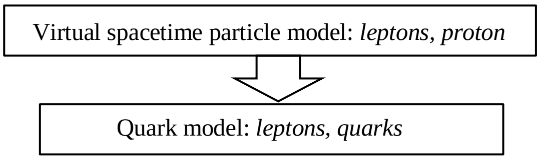

Fig. 3 Quark model derived from the virtual spacetime particle model

According to the process shown in Fig. 3, if the virtual spacetime particle model already exists, is the existence of the quark derived from the virtual spacetime particle model? The quark model is then constructed from several kinds of quarks. From a structural point of view, quarks are more subdivided than protons, and it seems that the level of protons is higher than quarks. However, it is noted that the leptons are equivalent to the quarks in the virtual spacetime particle model, which also means that if we can find the complete correspondence between the leptons and the quarks, the process shown in Fig. 3 is also achievable. such as

$$\sum_{i=1}^{3} k_i Q_i = P + \sum_{i=1}^{2} L_i \tag{2}$$

Equation (2) reflects the relationship between the quark model and the virtual spacetime particle model. Q_i on the left side of the equation represents quarks, and k_i is the proportional coefficient. The right side of the equation is the parameters of the virtual spacetime particle model, P is the proton, and L_i is the two types of lepton that make up the baryon. The lepton parameter does not need to be multiplied by any factor. Because as long as the two positive and negative lepton requirements of the virtual spacetime particle model are met, the requirements can be met.

4 Can a particle model based on virtual spacetime predict new results?

4.1 Comparison of two models

As can be seen from the above analysis, at least the quark model is based on a subset of the virtual spacetime particle model. So, does this mean that a particle model based on virtual spacetime can predict more particles beyond the quark model?

This can be used to classify and summarize the two models. It is shown in Table 1.

Table 1. Comparison of quark model and virtual spacetime particle model

Model	Quark	Virtual spacetime
Charge	Fractional charge	Integer charge
Total number	62 elementary particles	15 elementary particles
Number of leptons	6 kinds of lepton + 6 kinds of anti-lepton	6 kinds of lepton + 6 kinds of anti-lepton
Baryon	6 flavor quark + 6 flavor antiquark	1 proton + 1 antiproton
Color	Several colors	(none)
Composite particle structure	Quarks combination	Proton and leptons combination

Intermediate boson	Photon, W and Z boson, gravitational, Higgs	Photon
Isospin	1/2；-1/2 and etc.	1/2；-1/2 and etc.
Spin	1/2；-1/2 and etc.	1/2；-1/2 and etc.

It can be seen that the total number of elementary particles based on virtual spacetime is significantly reduced, leaving only 15 species.

In the intermediate bosons, both models have photon. However, in the particle model based on virtual spacetime, the W and Z bosons and the Higgs boson are just one of the composite particles. Consistent with the characteristics of the meson.

The gravitational boson in the virtual spacetime model does not exist. Because according to the assumptions of virtual spacetime physics and Einstein's general theory of relativity, gravitation is caused by the curvature of time and space, so no gravitational boson is needed to transmit gravitation. But it can be passed through gravitational waves. At present, gravitational waves have been supported by sufficiently solid experimental data.

Quark's unit is "flavor". Quarks of the same "flavor" have different colors and belong to different types of quarks. The elementary particles of the virtual spacetime model have no color. Therefore, the strong interaction is mainly caused by the special structure of the virtual and real spacetime.

4.2 Consistency between leptons and quarks

In the quark model, Leptons and Quarks have a lot of similarities. include:

1. Lepton is the same as the quark's "generation". There are three generations.

2. The number of "flavors" of lepton and quark is the same. There are 6 flavors.

3. Both the lepton and the quark have the "flavor" change ability.

4. The lepton characteristics of different "generation" and "flavor" are basically the same as the corresponding quark characteristics.

Because of the many similarities, is it doubtful that the quark and the corresponding lepton are actually the same particles? Quark's fractional charge effect has not been directly confirmed in experiments, perhaps indicating that the quark model is only a simple mathematical calculation method.

From the comparison of the quark model and the virtual spacetime model in Table 1, it is feasible to use the lepton directly instead of the quark, at least in some applications. And if we build a more complete virtual spacetime particle model, we should be able to get all the conclusions of the quark model.

To use the lepton instead of the quark, the main difficulty lies in the inconsistency of the charge.

One generation of the lepton includes a lepton with an integer charge and a lepton with no charge. However, all quarks are charged and are fractional.

In order to solve this problem, there is a rule in the quark combination, that is, the quark contained in a particle, the total charge must be an integer or 0. For this requirement, the particle model in the virtual spacetime is easy to satisfy. Because no matter how the lepton is combined, it will automatically ensure that the total charge of all the lepton is an integer or 0. Therefore, the combination of the internal lepton of the particle is arbitrary.

However, in the virtual spacetime particle model, the lepton inside the particle must satisfy a condition that the electric field radius of the lepton must be able to cancel each other out. This will meet the symmetry requirements of Section 2 of this paper. With such a restriction, it means that the lepton structure inside the particle must contain both positive and negative lepton, and the radius of these two leptons is the same. That is, the inside of the particle may contain electrons and anti-electron neutrinos, Muon and anti-Muon neutrinos, and the like. The combinations that cannot exist are electronic and anti-Muon neutrinos and the like. That is, the lepton that can be combined inside the particles must be the same generation. However, the quark model can be composed of quarks of different generations. For example, Λ particles are composed of the first generation of quark u, d and any quark of another generation.。

4.3 Beyond the quark model

1 Baryons

For Baryon, if we are involved in the entire particle table, it takes more effort to completely compare the virtual spacetime particle model with the quark model. Therefore, one of the more typical baryon particles is analyzed here. See if the virtual spacetime particle model gives some predictions beyond the quark model.

For the quark model, the Λ particle consists of two first-generation quarks u and d, plus any one second- or third-generation quark. There are four kinds of Λ particles, namely: *udc; uds; udt; udb*.

If the prediction is made from the virtual spacetime particle model, the Λ particle can be composed of one proton plus any pair of three generations of neutrons.

Where $p + e^- + \bar{\nu}_e$ is neutron. In the structure, if it is composed of antiprotons, anti-electrons and electron neutrinos, it is anti-neutron. For the sake of simplicity, only positive particles are discussed below.

In addition to neutrons, the combination of protons and leptons also includes:

$$p + e^+ + \nu_e$$

$$p + e^- + e^+$$

$$p + \mu^- + \bar{\nu}_\mu$$

$$p + \mu^+ + \nu_\mu$$

$$p + \mu^- + \mu^+$$

$$p + \tau^- + \bar{\nu}_\tau$$

$$p + \tau^+ + \nu_\tau$$

$$p + \tau^- + \tau^+$$

If a is used for lepton and ν_a is for corresponding neutrino, then the above structure can be expressed as

$$p + a^- + \bar{\nu}_a$$

$$p + a^+ + \nu_a$$

$$p + a^- + a^+$$

In this way, a total of 9 kinds of baryons can be constructed, and the corresponding 9 kinds of anti-baryons are combined, and a total of 18 kinds of particles are formed. This includes neutrons, which also contain all four Λ particles, as well as particles classified in other structures in the quark model.

As can be seen from the above analysis, all the particles predicted by the virtual spacetime particle model can be detected in the laboratory. Because the decay of these particles can certainly meet the conservation of parameters such as the number of baryons, lepton number, isospin and charge. It is only the quark model that makes fractional charges and so on, but instead limits its predictions for some of the more specific decay processes.

From the above analysis, it can be known that a new baryon is formed on the basis of the above structure, and the new baryon can also absorb the leptons and further constitute a more complicated baryon. such as

$$(p + a^- + \bar{\nu}_a) + a^- + \bar{\nu}_a$$

and many more.

And if it is formed as

$$(p + a^+ + \nu_a) + a^- + \bar{\nu}_a$$

This means that there may be more similar structures and decaying more of the other lepton pairs. such as

$$p + (a^{+} + a^{-}) + (\nu_a + \bar{\nu}_a)$$

and many more.

2 Mesons

According to the virtual spacetime particle model, all mesons are composed of two positive and negative lepton or positive and negative mesons, and no protons participate. Another such as Z^0, $W^{\pm}$, Higgs boson, etc., are classified as mesons in the virtual spacetime particle model.

Thus, each generation of lepton can form at least four mesons. which is

$$a^{-} + \bar{\nu}_a$$

$$a^{+} + \nu_a$$

$$a^{+} + a^{-}$$

$$\nu_a + \bar{\nu}_a$$

The fourth meson contains only neutrinos, but we don't know much about the characteristics of neutrinos at present, so the fourth meson cannot be measured at least under the current technical conditions. So, we can just use it as a theoretical model, which can be ignored in experimental exploration.

Such three generations of lepton can constitute three categories of 12 kinds of mesons.

Then consider that we can continue to form a new meson from two positive and negative mesons. In each generation, only charged mesons have antiparticles. This can continue to constitute the other three categories of mesons, each of which contains seven new mesons. There is a total of 3 × 7 = 21 new mesons.

The total number of the above two mesons reached 33. Some of these mesons, such as mesons composed entirely of positive and negative neutrinos, should not have the ability to detect at present.

Of course, if possible, you can construct a heavier meson on the basis of the newly formed meson.。

4.4 Suggestions for experimental detection

As can be seen from the analysis in Section 4.3, the virtual spacetime particle model is different from the quark model. Because the structure of the baryon is more complicated and the decay mode is more abundant, the difference between the two models is explored from the detection of new mesons. This has also been precedent in history. For example, the prediction and discovery of early Pion mesons.

For example, W^- boson, its virtual spacetime particle model can be expressed as $e^- + \bar{\nu}_e$. The *Z* boson in virtual spacetime particle model can be expressed as $e^- + e^+$

If considering combine it with W^+ and W^- together or with two Z^0 together to form a new boson H^0, that is

$$H^0 = W^-W^+ = (e^- + \bar{\nu}_e) + (e^+ + \nu_e)$$

$$H^0 = Z^0Z^0 = (e^- + e^+) + (e^+ + e^-)$$

According to the calculation of the *W* or *Z boson* mass in the paper [1], each *W* or *Z boson* consists of two leptons, each lepton has a diameter of *2a*, and the maximum range of the two leptons can be connected together to cover *4a*. However, the two leptons inside the *W* or *Z boson* cannot be completely overlapped, nor can they be connected to each other only on the sphere. Therefore, the average value *3a* is taken here, that is, the diameter of the *W* or *Z boson* is *3a*. However, considering that the two lepton and the boson formed are spherical, it may be more appropriate to take the geometric mean, ie $\sqrt{2 \times 4a} = 2\sqrt{2}a$.

According to the principle of uncertainty, for each of the two leptons forming the *W or Z boson* structure, each lepton will have

$$2\sqrt{2}a \cdot \Delta p = \frac{\hbar}{2}$$

$$E_l = \Delta p \cdot c = \frac{\hbar c}{4\sqrt{2}a}$$

This reflects the energy of the virtual photons carried by each lepton. Where *a* is the electron radius. According to the relationship between electron mass and proton mass in the paper [1] and the paper [2], it can be calculated

$$a = \frac{e^2}{8\pi\varepsilon m_p c^2}$$

Since *a* is very small, it can be seen $E_l \gg m_e c^2$, This allows the lepton mass to be ignored in the corresponding mass-energy relationship.

Considering that there are two leptons, the total energy or total mass of the *W or Z boson* is:

$$E_z = 2E_l = \frac{2\hbar c}{4\sqrt{2}a} = 90.9(GeV) \qquad (3)$$

From the experimental measurement data, the mass of the *Z* boson is 91.2 GeV, so the result of the formula (3) is close to that of the *Z* boson.

The reason why the mass of the *W* boson is much smaller may be that there is only one lepton charge in the composition of the *W* boson, so it is related that the two leptons can leave farther. If the two leptons are further away, the *W* boson will be larger than the Z boson and the mass of *W* boson will be smaller.

Then we calculate the new particle H^0 composed of two *W* or *Z bosons*. Considering two extreme cases, in one case, two *W* or *Z* particles overlap to form H^0 particles, and the diameter is $2\sqrt{2}a$. In this case, if the two *W or Z boson* spheroids are tangentially joined to form H^0 particles, the H^0 particle diameter is at most $4\sqrt{2}a$. Of course, such an extreme case should not exist, and thus is similar to the structural consideration of the *W or Z boson*. Here, the geometric mean value of *4a* is taken as the diameter of the H^0 particle. That is to say, the diameter of the new particle H^0 is *4a*. Of course, this is only an estimate and certainly brings a certain error. But it can bring us a more concise and clearer physical image.

This can estimate the mass of the new H^0 boson is about

$$E_h = \frac{4\hbar c}{8a} = 128(GeV) \tag{4}$$

At present, the Higgs boson mass is 126GeV, which is close to this new boson. Moreover, the Higgs particle also has a greater chance of decaying into two *W* or *Z* bosons. Other particles in this energy range have largely disappeared.

If such two *W* or Z bosons constitute the Higgs boson, then according to the combination of Section 4.3, there may be other combinations of structures. And their mass is similar to that of Higgs particles. For example, there may be H^+, H^- particles, and the like. This is not predicted in the quark model. In the virtual spacetime particle model, it is a simple inference. among them

$$H^- = W^-Z^0 = (e^- + \bar{\nu}_e) + (e^+ + e^-)$$

or

$$H^- = W^-Z^0 = (e^- + \bar{\nu}_e) + (\nu_e + \bar{\nu}_e)$$

and etc.

$$H^+ = Z^0W^+ = (e^+ + e^-) + (e^+ + \nu_e)$$

or

$$H^+ = Z^0W^+ = (\nu_e + \bar{\nu}_e) + (e^+ + \nu_e)$$

and etc.

The problem with the above combination is that the *W* particles and the *Z* particles are not mutually positive and negative particles. This is different from the composition of the virtual spacetime particle model. However, if the relationship between the *W* particle and the *Z* particle is the same as the relationship between the electron and the electron neutrino, it is in line with the virtual spacetime particle model. Perhaps this requires in-depth theoretical analysis and evidence from the final experiment to support it.

From the difference of mass between $W^{\pm}$ boson and Z^{0} boson, the difference between them is about $10GeV$, so the mass of $H^{\pm}$ boson is about $10GeV$ difference from the mass of Higgs boson. That is, we can find such positively and negatively charged bosons (or called charged Higgs particles) in the range of $110\sim140GeV$.

In addition, it can also be considered that in the $H^{\pm}$ boson structure, the W boson is charged, and the Z boson is not charged, so the radius of the $H^{\pm}$ particles formed may be larger, so the mass will be smaller. Thus $H^{\pm}$ may be less than 126GeV. Another consideration is that in the structure of $H^{\pm}$, the Z boson is 10GeV heavier than the W boson in the H^{0} structure, which may result in the mass of $H^{\pm}$ will be 136GeV. Therefore, the range of 110~140GeV is still a suitable energy range for $H^{\pm}$.

5 Conclusion

This paper explores the relationship between particle model based on virtual spacetime and quark model. From the discussion results, it can be seen that the virtual spacetime particle model is a larger set, including all the prediction results of the quark model. This is because the virtual spacetime particle model itself is based on the decay results and does not change any particle types that may decay.

Although the two are consistent in most of the predictions, some of these differences can be noted. The virtual spacetime particle model classifies some important intermediate bosons such as W and Z bosons, Higgs bosons, etc. into meson categories. That is to say, the actual structure of these bosons is similar to other types of mesons. Of course, their functions may differ.

In addition, the virtual spacetime particle model does not need to deal with problems such as fractional charge. Conservation laws such as conservation of charge, conservation of baryon numbers, conservation of lepton number, and conservation of isospin are automatically obtained. Therefore, it is much simpler than quark models when discussing problems such as particle decay.

It is precisely because the virtual spacetime particle model covers a wider range than the quark model. Therefore, all particles predicted by the quark model can be predicted by the virtual spacetime particle model. However, some particles can be predicted in virtual spacetime particle model, but the quark model can't.

For baryons, the number of particles involved is numerous and complex. The easiest way to distinguish between the virtual spacetime particle model and the quark model is the prediction of the meson and boson. In addition to all the mesons and bosons that have been predicted in the quark model, the virtual spacetime particle model also predicts the charged Higgs boson. This means that in addition to the $126GeV$ uncharged Higgs boson we now discover, there should be two oppositely charged Higgs bosons in nature, the two charged Higgs are positive and negative particles. Its mass range is approximately within the range of $110\sim140GeV$.

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基于虚时空的粒子模型与夸克模型的比较

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摘要：本文探讨了为什么基于虚时空的粒子模型与夸克模型的结果是一致的。夸克模型目前的最大问题就是为何夸克具备分数电荷，但是却又无法探测到。从狄拉克电荷量子化的条件来看，分数电荷是不满足电荷量子化条件的，因此不可能在实时空中观察到。否则我们将可以探测到磁单极子。然而夸克的分数电荷构造出不同的强子结构则又获得了强有力的实验证据的支持。这说明夸克的分数电荷具备了合理性。至少有了很强有力的间接支持。因此任何新建立的粒子模型，至少应该将夸克模型作为一个子集而存在。从本文的分析可以看出，虚时空粒子模型包含了夸克模型，能够预测出所有夸克模型预测出来的结果。但是虚时空粒子模型的范围更大，还能够预测出夸克模型不能够预测出来的新粒子。本文通过分析虚时空粒子模型中的介子模型，得出除了目前发现的希格斯玻色子之外，自然界还存在带两种带正反电荷的希格斯玻色子，这两种希格斯玻色子互为正反粒子，其能量范围大约为 110~140GeV，应该可以在 LHC 等对撞机上找得到。

关键词：夸克模型；虚时空；虚时空物理学；希格斯玻色子

1 导言

夸克模型在粒子物理中取得了很大的成功[5,6]，尽管有一些假设带有比较强的主观性，且一直未获得实验的直接证实。但作为一个能够预测出新粒子的理论，在一个非常高能量区域，且很难进行实验的条件下，获得这些成功，是非常难能可贵的。

然而夸克模型中的夸克带有分数电荷，这样的假设确实存在很多可以商榷之处。毕竟理论提出了五十多年的时间，至今还没有在实验室中有直接证据表明分数电荷的存在。另一个问题则是分数电荷与狄拉克电荷量子化条件是矛盾的。如果存在分数电荷，则也应该存在分数电荷量子化的情况。但夸克模型却无法给出如同狄拉克电荷量子化条件那样的结果[7]。尽管在狄拉克电荷量子化条件中需要磁单极子的存在，也虽然磁单极子至今没有被实验所发现，但是引入了虚时空之后，磁单极子就如同电荷一样，在虚时空中无处不在。这样的磁单极子与实时空中的电荷具备了更高度的对称性。因此电荷量子化的结果应该是整数的，而不是分数的。除非未来我们能够确定一种新的机制，能够保证将整数电荷分割成三份。目前来看，还没有任何理论或者实验的迹象存在。

2 基于虚时空的粒子模型

基于虚时空的粒子模型很简单[1~4]，首先假设所有最基本的粒子只有轻子和质子。这样实时空中的基本粒子就包括了六种轻子和一个质子以及它们的反粒子。

六种轻子分别是电子、电子中微子、渺子、缈中微子、陶子、陶中微子以及它们的反粒子。

质子是基本粒子中的唯一重子。

电子、渺子、陶子、质子都是带电荷的。而三种中微子则是不带电的。这都是符合狄拉克电荷量子化条件的。

所有基本粒子都是一样的，都是简单的球形结构。而带电荷的轻子则与对应的中微子半径一样。

对于带电荷的粒子，按照虚时空物理学的结论[1]，由于自旋导致的表面转动速度超过光速，这使得电子和渺子的半径位于虚时空中，因此在实时空是无法探测到的。而陶子和质子因为自旋而引起的表面转动速度小于光速，这意味着陶子和质子的半径是可以在实时空探测到的。

由于质子和陶子的半径可以在实时空中被测量到，而其他的轻子半径则位于虚时空，无法被测量到。加上所有轻子的半径都比质子要小，因此轻子可以进入质子、陶子等内部形成更多其他的复合粒子。

2 基于虚时空的粒子模型能够自动满足守恒条件

对于夸克模型，必须规定几个重要的守恒规律。分别是重子数守恒、轻子数守恒、同位旋守恒、电荷守恒等。

而很容易证明，基于虚时空的粒子模型能够自动满足所有的守恒条件。

首先基于虚时空的粒子模型中的复合粒子都可以用衰变后的产物来形成对应的粒子结构。

例如，如果存在重子 A 衰变成重子 B 和两个相反的轻子，则可以表示为：

$$A = B + a + \bar{a} \qquad (1)$$

大写字母表示重子，小写字母表示轻子。带上划线字母表示反粒子。

那么基于虚时空的粒子模型就可以得出 A 粒子的结构为由 B 粒子包含了两个轻子 a 和$\bar{a}$组成。

不过由于 A 是一个完整的粒子，因此轻子 a 的电荷必须重新分布与 A 粒子的表面。

之所以必须要有两个相反的轻子，是因为必须要将虚时空对应磁单极子的能量消除掉。否则所形成的复合粒子将获得比基础粒子 B 大很多倍的能量。

所形成的复合粒子可以用图 1 所示的粒子衰变图[1,3]来表示。

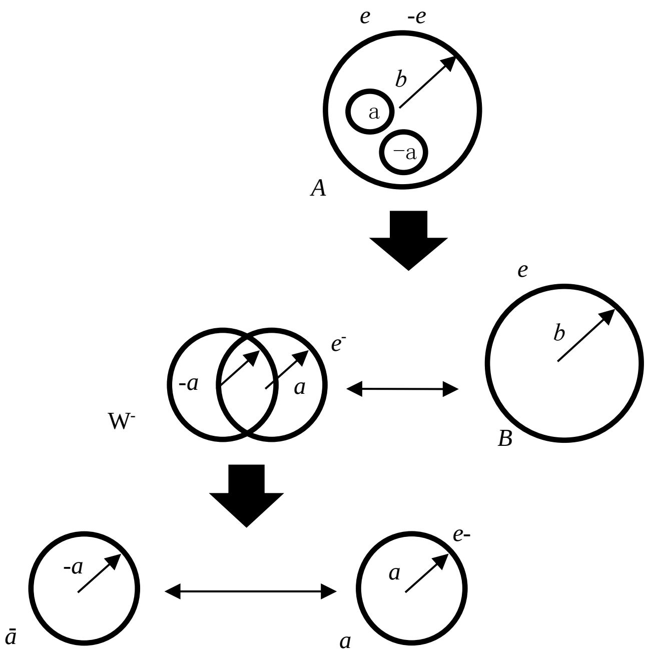

图 1 复合粒子的衰变图解

在这些复合粒子的反应过程中，衰变结果是什么，内部结构就包含了哪些粒子的结构。只是电荷需要重新分布于粒子的表面，并同基础粒子的电荷进行加减运算，这可以自然保证电荷守恒的基本要求。

而形成复合粒子 *A* 的能量不应该包含轻子在虚时空的能量，否则就会形成超大能量的粒子，比如在质子内部只有一个电子，则会导致所形成的复合粒子总能量超过质子两倍的情况。而且将破坏实时空中的粒子与虚时空粒子的对称性。

这种对称性的破坏可以这样来进行分析。

每一个粒子都是由虚时空和实时空两部分能量组成[1,4]。比如电子的实时空能量为电场，而虚时空能量为对应电-磁单极子磁场。质子的实时空能量为质子的电场，虚时空为对应的质-磁单极子磁场。

如果实时空仅仅一个电子进入质子内部，则实时空复合粒子将包含质子电场和电子电场，虚时空将包含质-磁单极子和电-磁单极子磁场。

现在我们从虚时空来看，由于质-磁单极子能量等于电子电场能量，电-磁单极子能量等于质子电场能量。从对称性来看，质-磁单极子就是虚时空的电子，而电-磁单极子就是虚时空的质子。

可以发现虚时空的质-磁单极子进入电-磁单极子，也将形成一个复合粒子。该复合粒子在实

时空对应的就是质子和电子。

也就是说如果仅有电子进入质子内部来构成复合粒子，将在虚实时空形成完全相同的一个复合粒子。即该复合粒子将同时跨越两个时空。或者说无论在实时空还是虚时空都可以测量到该粒子。这或许是确实可能存在的一种新粒子, 比如马约拉纳粒子等[8]。但目前并不知道有什么方法来进行探测。因此可以认为这种粒子结构的存在，意味着虚实时空是一个整体。因为只有一个整体的时空才会出现只有一种粒子，而没有对称粒子存在的情况。这就如同使用虚数的复数形式一样，一个复数中不可能包含既是实数又同时是虚数的数的存在。

因此为了避免出现这样情况，需要两个正反轻子来形成复合粒子的内部结构。故在基于虚时空粒子模型中，不需要做额外的重子数和轻子数守恒这样的约定。

对于电荷守恒和同位旋守恒的分析则更简单。考虑到复合粒子中已经包括了衰变之后的所有的粒子，且在复合粒子中，并没有将这些粒子的电荷和同位旋“删除”掉，因此复合粒子衰变前后的电荷与同位旋都是守恒的。

3、基于虚时空的粒子模型能够预测出所有夸克模型的重子

这一点也很容易理解。因为只要能够证实存在某种重子衰变过程。利用虚时空的粒子模型构成方法，直接将衰变产物中的轻子“放进”重子中，然后将轻子的电荷重新分布在该重子表面即形成了一个复合粒子。因此理论上所有夸克模型所预测出来的重子都可以纳入基于虚时空的粒子模型。不过在界定复合粒子这一概念的时候，基于虚时空的粒子模型中，质子是稳定的基本粒子，不可以再分割，也不会再衰变。

夸克模型和虚时空粒子模型之间的关系可以用图 2 来表示。

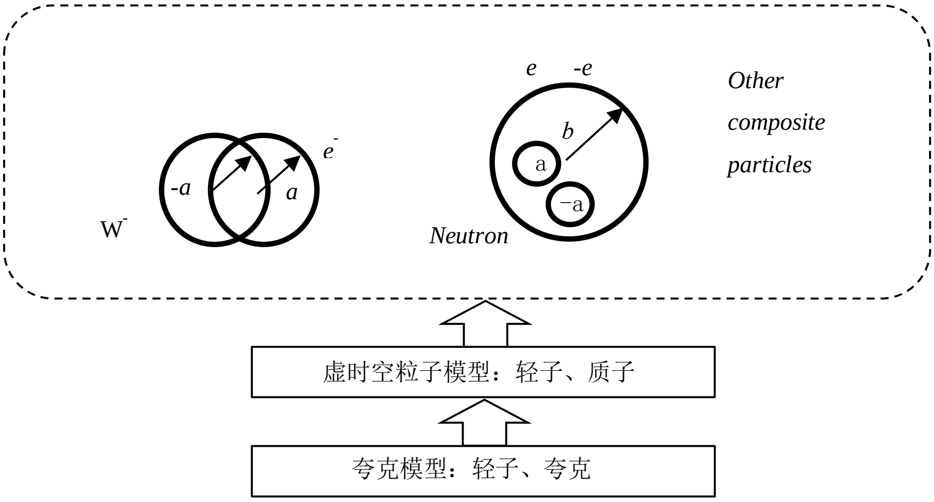

图 2 夸克模型与虚时空粒子模型的关系

从图 2 可以看出，夸克模型位于虚时空模型的底层，可以从夸克模型构造出虚时空粒子模型。而虚时空粒子模型是直接将衰变后的所有粒子产物组合在一起的，其包含的各种粒子参数与衰变后的所有粒子参数是完全一致的。因此在逻辑上来看，直接从虚时空粒子模型获得最终的衰变结果是没有问题的。

然而问题在于能否由虚时空粒子模型构造出夸克模型？如图 3 所示。如果能够由虚时空模型构造出夸克模型，则意味着这两种模型是完全等价的。如果不能够，则意味着虚时空粒子模型涵盖的范围要比夸克模型大。我倾向于后者。

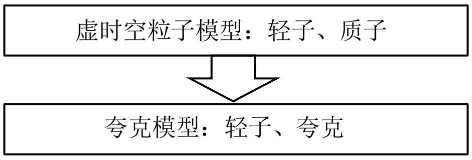

图 3 由虚时空粒子模型推导出夸克模型

按照图 3 显示的过程，如果已经存在虚时空粒子模型，那么都否由虚时空粒子模型推导出夸克的存在？然后再由若干种夸克构造出夸克模型。从结构上来看，夸克是比质子更细分的结构，似乎质子的层次比夸克更高。然而注意到在虚时空粒子模型中将轻子等同于夸克，这也意味着如果我们能够找到轻子和夸克的完全对应关系，图 3 显示的过程也是可以实现的。比如

$$\sum_{i=1}^{3} k_i Q_i = P + \sum_{i=1}^{2} L_i \tag{2}$$

公式（2）反映出的就是夸克模型与虚时空粒子模型之间的关系。等式左边 Q_i 表示夸克，k_i 是构成某个重子夸克的比例系数。等式右边是虚时空粒子模型的参数，P 表示质子，L_i 表示构成重子的两种轻子。轻子参数不需要乘以任何系数。因为只要符合虚时空粒子模型要求的两个正反轻子就可以满足要求了。

4、基于虚时空的粒子模型能否预测出新的结果？

4.1 两种模型的对比

从上述分析可以看出，至少夸克模型是基于虚时空粒子模型的一个子集。那么这是否意味着，基于虚时空的粒子模型还能够预测出超出夸克模型的更多的粒子？

可以这样来对两种模型进行归类和总结。

表 1 夸克模型与虚时空粒子模型的比较

模型	**夸克**	**虚时空**
电荷	分数电荷	整数电荷
总数	62 种基本粒子	15 种基本粒子
轻子数	6 种轻子+6 种反轻子	6 种轻子+6 种反轻子
重子	6 味夸克+6 味反夸克	1 个质子+1 个反质子
颜色	颜色	（无）
复合粒子结构	夸克的组合	质子与轻子的组合
中间玻色子	光子、W 和 Z 玻色子、引力子、希格斯粒子	光子
同位旋	1/2；-1/2 等等	1/2；-1/2 等等
自旋	1/2；-1/2 等等	1/2；-1/2 等等

可以看出基于虚时空的基本粒子总数显著减少，只剩下 15 种。

中间玻色子中，光子两种模型都是具备的。但是 W 和 Z 玻色子和希格斯玻色子在基于虚时空的粒子模型中，只是其中一种复合粒子而已。跟介子的特性一致。

虚时空模型中的引力子是不存在的。因为按照虚时空物理学以及爱因斯坦广义相对论的假设，万有引力是源自时空的弯曲造成的，因此不需要引力子来传递万有引力。但可以通过引力波来传递。目前引力波已经获得了足够坚实的实验数据的支持。

夸克的单位是“味”。同样“味”的夸克，颜色不同，也属于不同类型的夸克。而虚时空模型的基本粒子没有颜色。因此强相互作用主要源自虚实时空的特殊结构而产生。

4.2 轻子与夸克的一致性

在夸克模型中，轻子与夸克具备了很多的相似性。包括：

1、轻子和夸克的“代”相同。都有三代。

2、轻子和夸克的“味”数量相同。都有 6 味。

3、轻子和夸克都存在“味”的转变。

4、不同“代”和“味”的轻子质量与对应的夸克质量数量级上基本一致。

由于存在这么多的相似性，让人怀疑夸克和对应的轻子是否实际上就是相同的粒子？而夸克的分数电荷效应一直无法在实验中直接获得证实，或许表明，夸克模型只是一种单纯的数学上的计算方法而已。

从表 1 夸克模型和虚时空模型的比较来看，直接用轻子来代替夸克，至少在某些应用是可行的。而如果建立更完善的虚时空粒子模型，应该能够获得夸克模型所得出的所有结论。

要用轻子来代替夸克，存在的困难主要在于电荷不一致。轻子中包括了带有整数电荷的轻子，也包含了不带电荷的轻子。而所有夸克都是带有电荷的，而且是分数电荷。

为了解决这一问题，夸克组合中有一条规律，就是一个粒子所包含的夸克，其总电荷必须为整数或者是 0. 对于这一要求，在虚时空粒子模型种就很容易满足。因为无论轻子如何组合，会自动保证所有轻子的总电荷为整数或者是 0. 因而粒子内部轻子的组合有任意性。

不过虚时空粒子模型中，粒子内部的轻子要满足一个条件，即轻子的电场半径必须能够互相抵消。这样才能够满足本文第 2 节对称性要求。有了这样的限制，也就意味着粒子内部的轻子结构，必须同时包含正反两种轻子，且轻子的半径是一样的。即粒子内部可以包含电子和反电子中微子、渺子和反渺子中微子等。而不能够存在的组合则是电子和反渺子中微子等。即能够在粒子内部组合的轻子必须是同一代的。然而夸克模型则可以由不同代的夸克组成重子。比如 Λ 粒子，就是由第一代夸克 u、d 和另一代的任意一个夸克组成。

4.3 超越夸克模型

1、Baryon

对于 baryon，如果涉及到整个粒子表，要完整地将虚时空粒子模型与夸克模型进行对比，需要花费更多的精力进去。因此这里以其中一个比较典型的重子 Λ 粒子为例来进行分析。看看虚时空粒子模型能否给出超出夸克模型的一些预测。

对于夸克模型，Λ 粒子由两个第一代夸克 u 和 d，再加上任意一个第二代或者第三代的夸克组成。这样 Λ 粒子就有四种，分别是：$udc; uds; udt; udb$.

如果从虚时空粒子模型来进行预测，则 Λ 粒子可以由一个质子加上三代轻子中的任意一对组成。

其中$p+e^{-}+\bar{\nu}_e$是中子，而结构中，如果是反质子、反电子和电子中微子组成的则是反中子。为了简便，下面只讨论正粒子。

除了中子，质子和轻子的组合还包括：

$$p+e^{+}+\nu_e$$

$$p+e^{-}+e^{+}$$

$$p+\mu^{-}+\bar{\nu}_\mu$$

$$p+\mu^{+}+\nu_\mu$$

$$p+\mu^{-}+\mu^{+}$$

$$p+\tau^{-}+\bar{\nu}_\tau$$

$$p+\tau^{+}+\nu_\tau$$

$$p+\tau^{-}+\tau^{+}$$

如果用 a 表示轻子，ν_a 表示对应的中微子，则上述结构可以表示为：

$$p+a^{-}+\bar{\nu}_a$$

$$p+a^{+}+\nu_a$$

$$p+a^{-}+a^{+}$$

这样一共可以构造出 9 种重子，再加上对应的 9 种反重子，一共是 18 种粒子。这其中包含了中子，也包含了所有的四种 Λ 粒子，还包含了在夸克模型种分类在其他结构中的粒子。

从上述分析中可以看出，其实给予虚时空粒子模型预测出的所有粒子都是可以在实验室检测到的。因为这些粒子的衰变都肯定能够满足重子数、轻子数、同位旋和电荷等参数的守恒。只是夸克模型做了分数电荷等限制，反而会限制其对某些比较特殊的衰变过程的预测。

从上面的分析可以知道，在上述结构基础上构成了新的重子，而新的重子还可以吸收轻子，进一步构成更复杂的重子。比如：

$$(p+a^{-}+\bar{\nu}_a)+a^{-}+\bar{\nu}_a$$

等等。

而如果形成了

$$(p+a^{+}+\nu_a)+a^{-}+\bar{\nu}_a$$

这意味着还可能存在更多的类似结构，并衰变出更多的其他轻子对。比如：

$$p+(a^{+}+a^{-})+(\nu_a+\bar{\nu}_a)$$

等等。

2、Meson

按照虚时空粒子模型，所有的介子都是由两个正反轻子或正反介子组成，没有质子参与其中。另外诸如 Z^0, $W^{\pm}$, 希格斯玻色子等，在虚时空粒子模型中都被归类为介子。

这样每一代轻子至少可以组成四个介子。即：

$$a^{-}+\bar{\nu}_a$$

$$a^{+}+\nu_a$$

$$a^{+}+a^{-}$$

$$\nu_a+\bar{\nu}_a$$

其中第四种介子由于只包含了中微子，而目前我们对中微子的特性了解的很不深入，因此第四种介子至少在目前的技术条件下是不可以测量的。因此我们可以仅仅将其作为一种理论的模型而存在，在实验探测中可以将其忽略。

这样三代轻子就可以构成三大类 12 种介子。

然后再考虑可以还可以继续由两个正反介子构成新的介子。而每一代中只有带电荷的介子有反粒子。这样还可以继续构成另外三大类的介子，每一大类介子包含了 7 种新的介子。一共有$3\times 7=21$种新的介子。

上述两项介子总数达到了 33 种。其中部分介子，比如全部由正反中微子构成的介子，目前应该不具备能力去进行探测。

当然如果有可能，还可以在新构成的介子基础上再构造出更重的介子。

4.4 实验探测的建议

从 4.3 节的分析可以看出，虚时空粒子模型与夸克模型还是有所区别的。因为强子的结构更加复杂，衰变模式也更加丰富，所以探讨两种模型的区别还是从探测新的介子入手。这在历史上也是有过先例的。比如早期的 Pion 介子的预测与发现等。

比如W^-玻色子，其虚时空粒子模型可以表示为$e^- + \bar{\nu}_e$，而 Z 玻色子的虚时空粒子模型可以表示为$e^- + e^+$

如果考虑W^-与W^+组合或者两个Z^0组合在一起，形成一种新的玻色子 H^0，即

$$H^0 = W^-W^+ = (e^- + \bar{\nu}_e) + (e^+ + \nu_e)$$

$$H^0 = Z^0Z^0 = (e^- + e^+) + (e^+ + e^-)$$

按照文献【1】中有关 *W* 或 *Z* 玻色子质量的计算，每个 *W* 或 *Z* 玻色子由两个轻子构成，每个轻子的直径为 *2a*，两个轻子能够连接在一起的最大范围覆盖 *4a*. 但是 *W* 或 *Z* 玻色子内部两个轻子既不可能完全重叠，也不可能只在球面上互相连接。因此这里如果取算术平均值 *3a*，即 *W* 或 *Z* 玻色子的直径为 *3a*. 不过考虑到这两个轻子以及形成的玻色子是球形结构，取几何平均或许会更合适，即$\sqrt{2 \times 4}a = 2\sqrt{2}a$.

按照不确定性原理，对于形成 *W* 玻色子结构的两个轻子，每个轻子都有：

$$2\sqrt{2}a \cdot \Delta p = \frac{\hbar}{2}$$

或者：

$$E_l = \Delta pc = \frac{\hbar c}{4\sqrt{2}a}$$

这反映出每个轻子所携带的虚光子的能量。其中 a 为电子半径。按照文献【1】和文献【2】中有关电子质量和质子质量之间的关系，可以计算出：

$$a = \frac{e^2}{8\pi\varepsilon m_p c^2}$$

由于 a 非常小，可以看出$E_l \gg m_e c^2$，这样就可以在相应的质能关系式中忽略轻子质量。

考虑到有两个轻子，因此 *W* 或 *Z* 玻色子的总能量或者总质量为：

$$E_Z = 2E_l = \frac{2\hbar c}{4\sqrt{2}a} = 90.9(GeV) \qquad (3)$$

从实验测量数据来看，Z 玻色子的质量为 91.2GeV，因此公式（3）的计算结果与 Z 玻色子比较接近。

而 *W* 玻色子的质量要小很多的原因可能跟 *W* 玻色子构成中只有一个轻子带电荷，因此两个轻子可以离开的更远一些有关系。两个轻子离开的更远一些，则构成的 W 玻色子就会比 Z 玻色子大一些，自然质量就小一些了。

然后我们再来计算由两个 *W* 或 *Z* 玻色子构成的新粒子H^0，考虑到两种极端的情况，一种情

况两个 W 或 Z 粒子重叠在一起形成 H^0 粒子，则其直径为$2\sqrt{2}a$. 而另一种情况，两个 W 或 Z 玻色子球面相切连接在一起形成 H^0 粒子，则 H^0 粒子直径最大为 $4\sqrt{2}a$. 当然这样的极端情况应该是不存在的，因此与 W 或 Z 玻色子的结构考虑相类似，这里取几何平均值 $4a$ 作为 H^0 粒子的直径. 也就是说新粒子H^0的直径为 $4a$. 当然这只是一个估算，肯定会带来一定的误差。不过能给我们带来一个更加简洁而清晰的物理图像。

这样可以估算出新的 H^0 玻色子的质量大约是：

$$E_{\mathrm{h}} = \frac{4\hbar c}{8a} = 128(GeV) \qquad (4)$$

目前来看希格斯玻色子质量为 126GeV，与这个新的玻色子算是比较接近。而且希格斯粒子也有较大的几率衰变为两个 W或Z玻色子。这一能量范围的其他粒子已经基本上不存在了。

如果这样两个 W 或 Z 玻色子构成的就是希格斯玻色子，那么按照 4.3 节的组合，就可能存在其他的结构组合。而且它们的质量与希格斯粒子的质量差不多。比如可能存在H^+, H^-粒子等。这在夸克模型中是没有预测到的。而在虚时空粒子模型中则是一个简单的推论而已。其中：

$$H^- = W^- Z^0 = (e^- + \bar{\nu}_e) + (e^+ + e^-)$$

或者：

$$H^- = W^- Z^0 = (e^- + \bar{\nu}_e) + (\nu_e + \bar{\nu}_e)$$

等等。

$$H^+ = Z^0 W^+ = (e^+ + e^-) + (e^+ + \nu_e)$$

或者：

$$H^+ = Z^0 W^+ = (\nu_e + \bar{\nu}_e) + (e^+ + \nu_e)$$

等等。

上述组合的问题就是 W 粒子和 Z 粒子不是互为正反粒子。这与虚时空粒子模型中介子的构成有所区别。但如果 W 粒子和 Z 粒子之间的关系如同电子和电子中微子之间的关系一样，则又是符合虚时空粒子模型的。也许这需要深入的理论分析和最终实验的证据来进行支持。

从$W^\pm$玻色子和Z^0玻色子的质量区别来看，二者大约相差 10GeV，因此$H^\pm$玻色子的质量大约与希格斯玻色子的质量差 10GeV 左右。即可以在 110~140GeV 的范围中来寻找这种带正负电荷的玻色子（或者称之为带电荷的希格斯粒子）.

另外也可以考虑到$H^\pm$玻色子结构中，W 玻色子带电荷，而 Z 玻色子不带电荷，因此所构成的$H^\pm$粒子半径可能会比较大一些，故其质量也会比较小一些。这样$H^\pm$或许会小于 126GeV. 另一个考虑则是$H^\pm$的结构中，Z 玻色子比H^0结构中的 W 玻色子要重 10GeV，则可能导致所

构成的$H^{\pm}$玻色子的质量会是 136GeV. 因此 110~140GeV 的范围还是$H^{\pm}$存在的比较合适的能量范围。

5 结论

本文探讨了基于虚时空的粒子模型与夸克模型之间的联系。从讨论结果可以看出虚时空粒子模型是一个更大的集合，包括了夸克模型所有的预测结果。这是因为虚时空粒子模型本身就是建立在衰变结果基础之上的，并没有改变可能发生衰变的任何粒子类型。

尽管二者在大部分的预测结果中是一致的，但是也可以注意到其中的一些区别。虚时空粒子模型将一些重要的中间玻色子比如 W 和 Z 玻色子、希格斯玻色子等都归为介子类别。就是说这些玻色子实际上的结构同其他类型的介子是相似的。当然它们的功能则可能有所区别。

另外虚时空粒子模型不需要处理分数电荷等问题。电荷守恒、重子数守恒、轻子数守恒、同位旋守恒等守恒规律都是自动获得的。因此在探讨粒子衰变等问题的时候比夸克模型要简便的多。

正因为虚时空粒子模型涵盖的范围比夸克模型更广泛。因此夸克模型预测的所有粒子都可以通过虚时空粒子模型预测出来。但是有一些粒子虚时空粒子模型可以预测出来，而夸克模型则做不到。

对于重子来说，由于其中涉及到的粒子数目繁多且复杂。最容易对虚时空粒子模型和夸克模型作出区分的就是对介子和玻色子的预测。除了夸克模型中已经预测出来的所有介子和玻色子之外，虚时空粒子模型还预测出了带有电荷的希格斯玻色子。这意味着除了我们现在发现的 126GeV 的不带电荷的希格斯玻色子之外，自然界应该还存在两种带相反电荷的希格斯玻色子，这两种带电荷的希格斯玻色子互为正反粒子。其质量范围大约为 110~140GeV 范围之内.

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