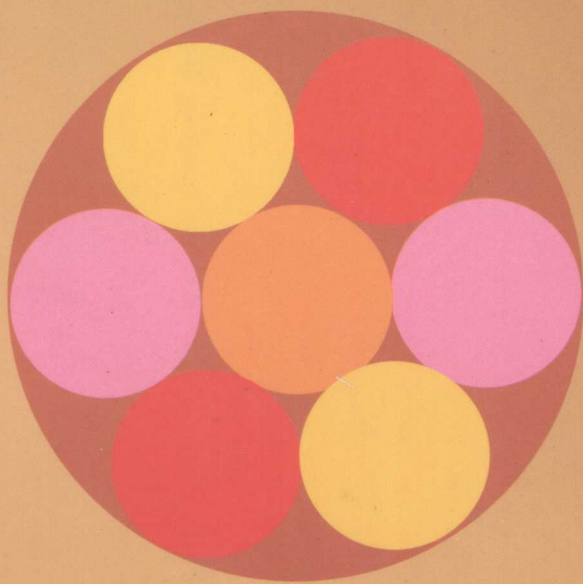


Discovering the spacetime towards grand unification

The Theory of Quaternarity

Kunming Xu



Xiamen University Press / Xiamen

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揭示时空奥妙和本质规律

四维球理论

许昆明 著

厦门大学环境科学研究中心

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内容简介

本书从简到繁逐步地、系统地剖析了时间与空间的几何与物质结构特征，创造性地发展出了四维球理论，与经典物理学、相对论和量子化学相统一，并把它用于定义惰性原子中的电子轨道和波方程，提出了2p 电子轨道的新几何模型，对电子运动和原子结构进行准确的描述和高度的概括。全书分两部分共八章，第一部分以严密的逻辑和数学推导阐述了时空的卷曲机制、电子的感应旋转、循环振荡和绳索现象，建立了用超级复数解析多维电子，揭示了三角函数、复数和微积分的内在联系。第二部分基于合理的假设，探讨了统一物理量和自然规律的方法和可能性，论述了四维球理论在生物学、统计学和哲学的普遍意义。

To the human civilization of the twenty-first century

Preface

Science is not merely about experiment, but about inspiration, insight, logic, and theory. The development of quaternity has spanned a decade since I was a graduate student at the University of Delaware at Lewes. Americans were on the wheels. A wheel inspired me to study the geometrical properties of a circle and a sphere; a swirl in the Indian River gave me much imagination; and the ebb and flow of the sea left me deep impressions of oscillations and waves. I gradually comprehended the approach of examining the world from the perspective of harmonic oscillation and space/time symmetry. With this consciousness and intuition, I reviewed critically classical electromagnetism and other advanced physics and tried to demonstrate a new science with mathematical logic. Chapters one, two, four, and six of this book were written in Dallas, Texas in 2000, but the draft has been modified several times over the years as more material was gathered and vague ideas became distinct concepts upon reflection over and over. It was after working at Xiamen University in the early 2002 that I spent most of my leisure time trying to organize many sporadic thoughts together and theorize them into this monograph, which presents a fresh spacetime concept of electronic orbitals and displays a snapshot of my worldview.

This book is intended for professional researchers as well as the general public who are interested in fundamental sciences. Although the text is short and the math is simple, the mindset is singular and unconventional. Before embarking on the journey of quaternity, it is better for readers to keep an open mind and be patience to absorb new proposals. For example, my preliminary research indicates that the world is symmetry about space and time, contrary to the principle of equivalence by Einstein, and particles such as electrons within a stable atom are orbiting around well-defined tracks according to their rotation rule analogous to planetary orbits, in contrast to the principle of uncertainty by Heisenberg. Although the theory of quaternity can be established without challenging the authority, I hope readers would forgive me when I do so for balance because I knew that some conservative scientists on the authority side would reject my thoughts flatly without hesitation.

History repeats itself in various fields. Human's research on space and time conception extending from the Euclidean geometry and the Newtonian time is like the continental expedition across the Atlantic from Europe in the 15th century. We had Albert Einstein who bravely sailed so far from the coast of the Euclidean until he could not see the land. But without finding another new continent on the boundless ocean, which was frightening, he had to return back bringing his venture record concerning space and time known as the theory of relativity. During the last century, although there have been a lot of scholars

navigating the same voyage, they gained little new insight and produced more controversies and misinterpretations than what it was envisioned. After finishing the final version of this book in August 2004, I told my former academic advisor, Dr. Stephen Dexter, that I had discovered a spacetime continent in science just like Columbus's discovery of American continent, consequently leading the world into a new era of exploration and colonization. But whether what I describe here is really a solid continent or is only a mirage in the ocean, I hope serious scholars can give me some feedbacks. Thank you!

Kunming Xu
September 2004

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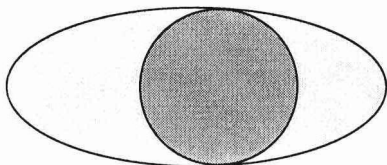
PART I. THEORETICAL BASIS

Scientific research in its various branches seeks not only to record particular occurrences in the world of our experience, but also to discover the general laws hidden behind the apparent phenomena. Although natural laws are independent of the observers, people watching a specific event from different perspectives or in different contexts usually arrive at different depths of understandings and explanations. Some accounts are more fundamental than the others. Newton's perception on a falling apple in the presence of gravity was more fundamental than other people's casual observations. This treatise describes my thrilling discovery of the theory of quaternity, which is so wonderful and fascinating that I believe it reflects nature on its utmost fundamental level.

The theoretical basis of quaternity lies in the novel conception of space and time. In the Euclidean geometry, it is difficult to understand a system with more than three dimensions of space. When describing the motion of an object, we tend to treat the object as a point particle and record its position in X, Y, and Z directions at every instant of time. Such a three-dimensional curve is known as the world-line of the point particle. This traditional approach does solve a lot of classical mechanics problems, but it assumes uniformity of time and hence is not feasible to characterize the oscillation of electrons where multiple levels of time and space are involved. Instead of using X, Y, and Z orientations as axes, the theory of quaternity adopts a new set of coordinates such as displacement, velocity, and acceleration, etc. where each axis has a different space and/or time dimension so that the coordinates define electronic motions at multiple spacetime profiles simultaneously.

The first part of this book explains the basic rationale of quaternity through the description of electronic orbitals within inert atoms. The first chapter introduces the principle of space and time symmetry in the two-dimensional sphere of a helium atom where space and time are dynamically represented by two electrons. The second chapter provides a geometrical model of four-dimensional spacetime with the electronic octet in neon shell as a material instance. The distinctive approach of quaternity is that it regards space and time as inherent physical properties that cannot be divorced from physical objects themselves, and the description of electronic wavefunctions naturally constitutes an illustration of canonical spacetime properties. Three orientations of X, Y, and Z do not mean three dimensions automatically, but rather each dimension is associated with a real electron. Quaternity space takes the size of points into considerations and can be conveniently extended to multiple dimensions through dimension curling up mechanism. The third chapter discusses quantitative dynamic equilibrium and spacetime structure of electrons within an argon atom, which set the stage for unfolding advanced features of multi-dimensional

spacetime in chapter five as we formulate wavefunctions for 3d-and 4f-orbitals by super-complex functions. The fourth chapter unifies quantum theory and special relativity under the framework of quaternary view, and hence demonstrates the great capacity of the new science. By the principle of rotation operation, we formulate a precise wavefunction for every electron in various inert atoms with continuous and layered spacetime structure. These five chapters establish quaternary spacetime step by step through rigorous mathematical logic. In particular, the discoveries of dimension curling up mechanism and rotation operation principle lay the keystones of the theory of quaternary.



Motif 1. Circle, sphere, convolution, pupil, portal, and perception.

Chapter 1

Space, Time, And Duality

1. 1 Conventional spacetime concept

Since antiquity, human creatures have believed that they know about space and time because of their direct experience, but scientific conception of space and time turns out to be elusive. While their meanings seem intuitively clear, attempts to define them encounter remarkable difficulty. This is not because space and time are so complex but rather they are so fundamental that there is not a single preceding rule for their reference. Space and time are the foundation and background of all sciences. They are the stage of an act, the theme of a song, and the context of a paragraph. The importance of them can never be overestimated. How we define them actually determines our perspective and standpoint, from which we gain our worldview of the surrounding environment. It goes without saying that any heavy-duty successful theories must cope with space and time concepts properly. Significant examples are the Newtonian mechanics and Einstein's relativity.

The ancient Egyptians learnt to measure lands and constructed pyramids thousands of years ago. By Newton's time, people had been getting pretty good at elementary Euclidean geometry such as finding relationships between lengths and angles in triangles and other polygons, calculating the surface areas and volumes of cones, and modeling three-dimensional space using the Cartesian coordinates. But what about time? Time is more mysterious than space. For the kids, it is a stretching uncertainty and expectation in the future. For the adults, it seems to be an immaterial stream that mercilessly sweeps them towards oldness and death, fearing it or not. Can we model time using some version of the Euclidean coordinate system? Isaac Newton thought about this and defined that "Absolute, true and mathematical time, of itself, and from its own nature, flows equably, without relation to anything external." Given such a postulate, he developed three laws of motion that formed the core of classical mechanics. Simple as it was, yet it has been the most practical and fruitful interpretation of space and time since then.

Space and time were customarily considered to be separate quantities until 1900s when Minkowski proposed a four-axis spacetime continuum, in which a time dimension is coupled together with three dimensions of space through events. Minkowski's four-axis coordinates became the framework for Einstein's special theory of relativity^[1]. The theory explained that space is relative, and time is relative, too. They are relative in the sense that when an object travels at a high

speed, its time dilates and length contracts compared with those of rest objects. Such an unusual conclusion was demonstrated by Lorentz's transformations connecting an inertial reference frame and another frame moving at a constant velocity relative to it. In his general theory of relativity, Albert Einstein further proposed that time curves in the space around stars and other massive objects and came up with an equation relating the curvature tensor of the distance function to the distribution of matter and energy in spacetime. This set the tone for later scholars of all kinds of interests to explore the physical properties of topological space.

In 1919, Theodor Kaluza unified Maxwell's electromagnetism and Einstein's theory of general relativity and gravity by adding a fifth dimension. He suggested that the fifth space dimension normally curls up and is hidden from direct visualization. Modern string theories inherited the coiled dimension idea and further proposed that spacetime was composed of 10 or 11 dimensions of space and one dimension of time. Although there are many versions of string theories now and many people are fond of it, none of them is convincing. Up to now, the theory of relativity has been the most well regarded spacetime theory where space is three-dimensional and time is one-dimensional, both forming a four-dimensional spacetime continuum where the spacelike and timelike directions are distinguishable. In any current theories, time is assumed to be one-dimensional and hence is not considered to be the counterpart of or in symmetry to space.

Despite all progress, our conception of spacetime still originates from and is limited by intuitive observations that are framed by the Euclidean geometry and the Newtonian time. We see three-dimensional objects occupying our surroundings, and we feel the passing of time in each day. But have we grasped the most fundamental aspect of space and time in physics? Does the Euclidean geometry reflect the reality in its essence? I don't think so. The Euclidean geometry does not incorporate time axis into three-dimensional space framework. Time remains isolated from space. Moreover, the mathematical abstraction of three-dimensional space normally disregards the size of geometrical points, which deviates from real world objects.

Because of the great success of Newton's laws, can we take it for granted that all entities from atoms to the whole universe have the same space and time properties as our living environment? I would not do so. Such an extrapolation is potentially dangerous because it goes beyond what the evidences warrant. For example, classical mechanics works perfectly on the ground, but it breaks down when applied to a large astronomical distance. Objects are no longer traveling in a straight line as predicted by Newton's first law of motion, instead geodesics represent the paths of freely falling particles in a given cosmic space. Relativity becomes meaningful in explaining the discrepancy. Thus the extension of classical mechanics to curved space is invalid. Moreover, turning our focus to microscopic world, the principle of uncertainty precludes the applications of

Newton's laws either. Quantum mechanics has to be called for to characterize the behavior of electrons. However, quantum mechanics uses statistical probability to describe electronic orbitals, and this approach is radically different from that of classical mechanics. Currently, relativity and quantum physics remain detached and must be unified. Since space and time are the most relevant quantities in all physical motions, the drawbacks of the Euclidean space and the wanting unification of relativity and quantum mechanics prompt us to search for new space and time concepts on a more profound level.

1.2 Two-dimensional spacetime

If we admit that somewhere in the particle microcosm or in the universe, space and time might be different from what we are used to, then we need to be cautious on any presumptions that we have inadvertently introduced for none of us sees the world with pristine eyes. Let's discard every antecedent belief and premise except saying that space and time are a pair of fundamental physical quantities. There may be many relevant quantities in a system, but I just call the pair of the most fundamental ones space and time. The rationale of choosing two rather than one or three can be justified from our knowledge of philosophy.

Our common sense inclines to support two first-degree physical quantities, which may refer to up and down, positive and negative, yin and yang, male and female, on and off, yes and no, etc. Looking at the symmetry of a leaf, of a cashew nut, of a human body, and of the earth, there must be at least two sides or two poles in them. Physically, Newton's third law indicates that for every action, there is an equal and opposite re-action. All suggest the existence of two polarities.

Technically, to describe a certain property, one needs to establish a reference first, e.g. up position is relative to down, and male is in contrast to female. Hence at least two quantities are needed anyway as fundamental quantities. Using one quantity as the reference, the other as a ruler, these two quantities can sufficiently measure everything in the world. Any third quantity could be derived or computed from the two through certain combinations or transformations, which is not so fundamental as the two. We have seen that binary numbers can actually describe everything that a computer or a robot does, the capabilities of which appear unlimited. Given these considerations, it is reasonable to assume that there are exactly two fundamental and basic quantities, namely space and time. From this reasoning, the definition of space and time is relative, i.e. if the first one is designated as space, then the second one as time, or the other way around, even though we tend to associate space with volume and time with flow. Nevertheless, both quantities are coupled intimately since a dynamic volume flows away and a flow naturally leads to a reservoir volume.

To expatiate on what space and time are, we notice that there are two electrons within a helium atom. We may associate space with one electron, and time with the other, or in a more general manner as will be introduced. Both electrons are stable and should best represent the two basic quantities. It is by this approach that we explore the property of space and time through the description of the atomic structure as follows.

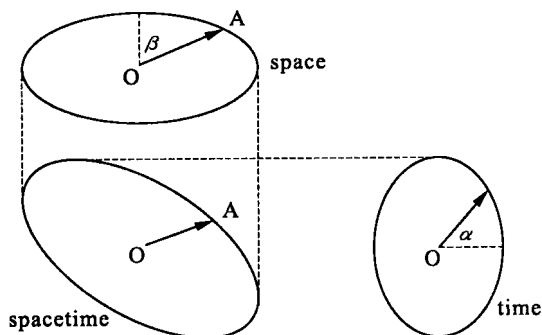


Figure 1.1 Oscillation movement of an electron within a helium atom where its time factor is determined by the rotation of α angle and space factor by the rotation of β angle.

Let's consider the motion of electrons in a helium atom. An electron may have space and time properties, or say that an electron lives in a two-dimensional spacetime. As shown in Figure 1.1, an electron is confined to a space sphere as well as to a time sphere. But space and time are inseparable. They are inherently coupled together, holding the electron like an envelope. In other words, the electron possesses space component as well as time component as it is orbiting around the nucleus. When the electron is occupying space, space bulges but meanwhile exerts a compressing force on the electron. Similarly, when the electron is living in time, time plumps up and puts a shrinking force on it. The magnitude of the forces is proportional to the space or time quantity that the electron occupies. Under these conditions, the motion of the electron is best described by a harmonic oscillation. The stable oscillation without damping can be expressed as:

$$\frac{d^2\Psi}{dt^2} = -\omega^2\Psi \quad (1.1)$$

where Ψ is time component of the electron and ω denotes angular velocity. One is tempted to compare this equation with Schrödinger's equation, which is much more complicated. But bear in mind that we are dealing with two-dimensional spacetime where space and time have non-classical meanings. Actually the formulation of Schrödinger's equation also started from the rudimentary idea of harmonic oscillation with the shape of equation (1.1). The complexity of Schrödinger's equation beyond equation (1.1) is unnecessary in the