

STANDARD SPACE-TIME THEORY

A New Self-Consistent Theoretical System

Tan Shusheng



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PREFACE*

It has been 400 years since the Renaissance, the generation and development of modern sciences based on materialism have empowered people to build their way out of ignorance, to grasp rational thinking, and to enhance their ability of controlling and harmonizing the nature. Especially in the 20th century, the great achievement of physics nurtured the rapid development of atomic energy, micro-electronics, laser, computer science and other new technologies and industries. The achievements created by people in all scientific and technological fields in the 20th century exceeded the totality of accomplishments in the past. These achievements have changed the human society in the ways of life and production, improved people's well-being, and accelerated the social progress. Therefore, China took 'developing the country through science and education' as its basic state policy in the 1990s.

However, modern science has only a short history yet, and the accumulation of scientific knowledge is insufficient and incomplete. The existing theories are generally like hurriedly-written essays, mostly featuring limitations and characteristics of the times. The nature is like a long and never-ending river, and one generation cannot reach the land of absolute truth with one move. When we have not yet made clear the old questions such as the beginning of the universe, the history of substance, the origin of life and intelligence mechanism, new problems come up one after another. Philosophers hold the opinion that the absolute truth is at infinity.

Science is the common wealth of human beings. Only through endless attempts by one generation after another can we grasp part of the profound mystery of the nature. Life is so short that the chief scientists managing scientific knowledge have to change only after decades. The later generation will take the scientific heritage of the contemporary scientists and will become its new owners. It is not right to state that the problems having been studied by predecessors cannot be modified by the later generation, no matter how significant the existing

* This is the preface written originally for my book *From Special Relativity to Standard Space-Time Theory* (in Chinese) by Song Jian, and I use it here for the preface of this book. —author

achievements are! Each generation has the responsibilities and rights to inherit and develop science. History has testified that the later generation can do better than the former, and can surpass them.

Professor Tan Shusheng has been making more than 20 years of painstaking efforts to create the standard space-time theory. As a new self-consistent theoretical system, it succeeds and integrates the basic ideas and achievements of Newtonian mechanics and Einstein's theory of special relativity. Both encompassing the acquired knowledge and exhibiting a good deal of originality, this new system has eliminated the original paradox, and opens a new field of vision, which is of great significance to the development of physics. The publishing of this book *From Special Relativity to Standard Space-Time Theory* will be conducive to readers' study and application of modern physics.

Song Jian

Member of the Chinese Academy of Sciences

Member of the Chinese Academy of Engineering

Former President of the Chinese Academy of Engineering

INTRODUCTION

The standard space-time theory (SST) is an original theoretical achievement, a new self-consistent theoretical system based upon two basic postulates, i. e. (1) the principle of the absolute reference frame and (2) the principle of the constancy of the average circulation speed of light. SST has perfectly explained up to now all the observational and experimental facts, including several kinds of experiments which cannot be explained by special relativity (SR). The SR is a limited case of SST under a certain condition.

Differing from the special relativity of Einstein, the great Dutch physicist H. A. Lorentz considered that there are absolute reference frame and absolute motion. A. Einstein said, 'What is the meaning of the sentence *there is not only relatively uniform motion along a straight line but also absolute uniform motion along a straight line*? That is only to say, there is a coordinate system in which some natural laws are different from those in all other coordinate systems. Hence this means that each observer can make comparisons among the laws effective in his coordinate system and those in the specific standard coordinate system, so that he might judge whether his own system is in motion or at rest.' SST is indeed conformed to this statement. This is why it is called 'standard space-time theory'.

A. Einstein's special relativity was presented to the world just more than a century ago, it has become one of the main foundations of modern physics. However, theoretical thinking and experimental tests should always be pursued to reveal the drawbacks and difficulties of those original theories and pave the way for the creation and development of new theories. The special relativity has faced potential challenges.

First, the first basic postulate of SR, i. e. , the relativity principle, is in sharp conflicts with modern cosmology, as the latter agrees that there is a 'cosmic standard coordinate system' in the universe, in which the cosmic standard time scale to describe cosmic revolution is a relatively preferred scale and the simultaneity relative to this scale has essential meaning in cosmic revolution; the cosmic space is the cosmic background space where typical galaxies or clusters of galaxies are uniform and isotropic, and observations in a reference frame moving with a certain velocity relative to this background space have manifested the deviation from the uniformity and isotropy. The cosmic standard coordinate system is a

preferred reference frame, and the motion velocity of any moving coordinate system (such as the earth) relative to this background space can be measured in principle. This point of view is supported by many astronomical observations, including the 2.7k cosmic background radiation, from which we conclude that the absolute velocity at which our Earth goes through this ‘cosmic background’ is about 390 km/s. This is the so-called ‘new ether drift’. Many physicists are convinced of the factual existence of the absolute reference frame.

Second, many authors have pointed out that there is a logical cycle between the measurement of the one-way speed of light and the synchronization of clocks at different places. This cycle is not avertable in SR. The principle of the constancy of the one-way speed of light is not examinable by virtue of the synchronization of clocks of different places, and is an artificial and excessive postulate. Detailed analyses about the experiments to test the principle of the constancy of light speed show that every kind of experiment has proved and has only proved the constancy of the average two-way speed of light, or circulation speed of light, but none has proved the constancy of the one-way speed of light.

The most important conclusion of SR is that the speed of light in vacuum is the limit speed of matter motion. According to SR, the existence of superluminal motion definitely causes the violation of the causality. Realizations and observations of the superluminal phenomena using quantum tunnel effect have been turned into a craze since 1990s. Experiments have affirmed that a photon or an electromagnetic pulse in short wave, microwave or optical wave can pass through the potential barrier with superluminal speed. The experimental examinations of Bell’s inequalities are also important advances. Nowadays, physicists have generally accepted the violations of Bell’s inequalities as experimental facts. These experiments show that the predictions of quantum mechanics are correct; intrinsic dependencies and correlations against Einstein’s locality principle do exist among space like separated events. This is the nonlocal effect of quantum mechanics. Hence, these experiments are called distant correlation experiments.

The famous magazine *Scientific American* (March 2009, Vol. 300, No. 3, pp. 32-39) published in 2009 a long article titled ‘Was Einstein Wrong? A Quantum Threat to Special Relativity’. The authors D. Z. Albert and R. Galchen wrote: ‘The greatest worry about nonlocality, aside from its overwhelming intrinsic strangeness, has been that it intimates a profound threat to special relativity as we know it. In the past few years this old worry—finally allowed inside the house of serious thinking about physics—has become the center-

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piece of debates that may finally dismantle, distort, re-imagine, solidify or seed decay into the very foundations of physics. '

'The kind of nonlocality one encounters in quantum mechanics seems to call for an absolute simultaneity, which would pose a very real and ominous threat to special relativity. That's the rub. '

'This nonlocal effect is not merely counterintuitive; it presents a serious problem to Einstein's special theory of relativity, thus shaking the foundations of physics. '

K. R. Popper and J. S. Bell et. al. asserted the most reasonable way to interpret the distant correlation experiments would be returning to the hypothesis of absolute reference frame and Lorentz's space-time theory. For example, J. S. Bell (1928 – 1990) is the excellent scientist at CERN, and his viewpoints are especially clear. Early in 1985 Bell said (See *The Ghost in the Atom*, Edited by P. C. W. Davies and J. R. Brown, Chapter 3, Cambridge University Press, 1985):

'The low cost solving means is to return to the relativity theory before Einstein. The men in that time, such as H. A. Lorentz and H. Poincare, considered that there is the *ether*, i. e. , a preferred inertial frame of reference. '

'I have discovered that many problems can be solved still easily by means of assumption of ether existence. Here I wish to return to the conception of ether, because in these EPR experiments there is this reveal, i. e. , certain thing back of the phenomena goes faster than the speed of light. '

However, Lorentz's efforts were realized with a series of revisions, supplements and additions of hypothesis to classical physics. His theories were not systematic and thorough. The Lorentz transformation is contradictory with his original idea of the ether theory. Lorentz did not set up a space-time theory in accordance with the principles of logical simplicity and logical self-consistency. Hence to return directly to the Lorentz theory is not the most perfect resolving means.

The SST is the perfection and systematization of the Lorentz space-time theory. It makes people return to the direction of H. A. Lorentz to probe into the essence of space-time. It is a logic system based upon the above-mentioned two basic postulates. It is able to overcome these difficulties and challenges which SR is facing. SST has accomplished first and independently the work as follows:

1. Starting strictly from the above two postulates, we have derived the space-time coordinate transformations between an ordinary inertial frame and the standard inertial frame,

i. e. , the generalized Galilean transformations (GGT). The Lorentz length contraction hypothesis and time dilation hypothesis are built on the basis of the existence of the absolute reference frame. Starting from the Lorentz hypotheses we have also derived the space-time coordinate transformations between an ordinary inertial frame and the standard inertial frame, which are not the Lorentz transformation but the generalized Galilean transformation.

2. The SST has gained the absolute simultaneity so it permits the existence of superluminal motion without the difficulties of the causality violation. The time idea of SST is qualitatively close to that of quantum mechanics. So it is in keeping with the nonlocality of quantum mechanics. SST has dealt with the kinematical and dynamical problems of subluminal and superluminal motion uniformly and strictly from GGT.

3. Whatever objective laws do the electromagnetic phenomena obey? Maxwell's equations and the Lorentz force formula have given answers to this question. These are an electromagnetism theory which is the correct theory universally recognized up to now. According to Maxwell's and Lorentz's ideas, Maxwell's equations and the Lorentz force formula hold true only in the ether absolute frame; but in an ordinary inertial frame at a uniform rectilinear motion to the absolute frame, the laws of the electromagnetic fields will manifest the definite deviations from Maxwell's equations and the Lorentz force formula. Then, what concrete forms do the laws of the electromagnetic fields in ordinary inertial frames take? Neither Maxwell or Lorentz has given a final and definite answer. Starting from the basic postulates of SST and the principle of the constancy of charge and Coulomb's law, we discover and formulate the electromagnetic field laws in ordinary inertial frames, and establish the transformation between the electromagnetic quantities in the absolute inertial frame and that in an ordinary inertial frame, and by using them we can explain and predict all kinds of experimental electromagnetic phenomena, therefore the whole electrodynamic system of the standard space-time theory is found.

4. The SST has proved that the experiments do not necessarily entail ordinary 'special relativity', since they are compatible with the conception (such as the absolute reference frame and the absolute motion) that is significantly different from that of SR. SST has perfectly explained till now all the observational and experimental facts, including several kinds of experiments which cannot be explained by special relativity.

The SST is a new self-consistent and systematic space-time theory that is different from Newton's absolute space-time viewpoints and Einstein's relative space-time viewpoints, meanwhile, SST inherits and integrates the reasonable elements of both perspectives. It may

INTRODUCTION

provide a more reasonable space-time frame for understanding and describing the physical world and natural phenomena. Time will lead mankind to approach and accept truth. It is promising that through the accumulation of more experimental facts, SST will be widely accepted by people.

The SST has begun in gestation since 1979 and has been founded in 1983. On September 2nd, 1983 the article ‘the standard space-time theory’ was submitted to the editorial board of *Journal of National University of Defense Technology* and was published in the No. 1, 1984 issue of this journal (pp. 151-202). The subsequent relative articles have been published in several journals and the monograph was published in 1992. The standard space-time theory has received warm appraisal from Chinese well known professors Zhao Yijun, Bai Mingfu, Kuang Huisun, Dong Guangbi, Ge Xuchu, famous scientists Qian Xuesen and Song Jian, and internationally renowned physicists B. d’Espagnat and J. S. Bell et. al. The book *From Special Relativity to Standard Space-Time Theory* (in Chinese) (Changsha: Hunan Science and Technology Press, 2007, pp. 457) has deeply and explicitly expounded every aspect of SST. In China, SST is well known to readers and attracts attentions and interests from many scientists. Naturally, SST should be introduced to the whole world and be known to all the researchers and students to inspire more discussions and studies, so as to promote the progress of science. The present book entitled *The Standard Space-Time Theory: A New Self-Consistent Theoretical System* (in English) is a narration of the essence of SST.

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Chapter 1

Basic Postulates and Coordinate Transformation of the Standard Space-Time Theory

Based upon the latest experimental facts and the achievements of theoretical thinking in modern physics, this chapter advances two postulates about the properties of space-time: 1) the principle of the absolute reference frame, and 2) the principle of the constancy of the average circulation speed of light. Obviously, these two postulates are different from those of Einstein's special relativity theory (SR). They are the fundamental postulates for constructing a new space-time theory, here called 'standard space-time theory'. Strictly from the above two postulates, this chapter derives the space-time coordinate transformation between an ordinary inertial reference frame and the standard inertial reference frame, i. e., the Generalized Galilean Transformation (GGT)

1 Introduction

A. Einstein is the greatest physicist in the 20th century, and his special relativity (SR) has become one of the main bases of modern physics. But theoretical thinking and experimental tests should always be pursued to reveal drawbacks and difficulties of those original theories and open up the way to the creation and development of new theories. Let us now review what potential challenges special relativity is facing.

First, the first basic postulate of SR, i. e., the relativity principle is in complete conflict with modern cosmology. According to modern cosmology^[1], there is a 'cosmic standard coordinate system' in the Universe, in which the cosmic standard time scale to des-

cribe cosmic revolution is a relatively preferred scale and the simultaneity relative to this scale has essential meaning in cosmic revolution; the cosmic space is the cosmic background space and in it typical galaxies or clusters of galaxies are uniform and isotropic, and the observations in a reference frame moving with a certain velocity relative to this background space have manifested the deviation from the uniformity and isotropy. The cosmic standard coordinate system is a preferred reference frame, and the velocity of any moving coordinate system (such as the earth) relative to this background space can be measured in principle. This point of view is supported by many astronomical observations, including the 2.7k cosmic background radiation, which was discovered by Penzias and Willson^[2] in 1965. Researches^[3] have proved there is a strict isotropy of the background radiation only in an inertial reference frame, and the observations in any reference frame moving relative to this inertial reference frame have manifested the direction changes of the radiation temperature. The measurements of the small deviation of the background radiation temperature to reach to our earth from every direction have gained that its maximum exceeds the average value by 0.0035k and directs to the α star in Leo. From this we can conclude that the absolute velocity with which our earth goes through this 'cosmic background' is about 390 km/s. This is the so-called 'new ether drift'. Many physicists are convinced of the factual existence of an absolute reference frame. Dirac^[4], Bergman^[5], Rosen^[6], Weisskopf^[7], Stapp^[8], Harken^[9], Bohm and Hiley^[10], Hu Ning^[11] and other authors consider that the ether hypothesis should be restored, and the 2.7k background radiation has determined an isotropic preferred absolute coordinate system.

Second, many authors have pointed out that there is a logical cycle between the measurement of the one-way speed of light and the synchronization of clocks at different places^[12-14]. This cycle is not avertable in the special relativity. The principle of the constancy of the one-way speed of light is not examinable by virtue of the synchronization of clocks of different places, and is an artificial and excessive postulate. The detailed analyses about the experiments to test the principle of the constancy of light speed show that every kind of experiment has proved and only proved the constancy of the average two-way speed of light, or the circulation speed of light, but none has proved the constancy of the one-way speed of light.

The most important conclusion of SR is that the speed of light the vacuum is the limited speed of matter motion. The realization and observation of the superluminal phenomena using the quantum tunnel effect have been turned into a craze since 1990s. The experiments have affirmed that a photon or an electromagnetic pulse in short wave, microwave or optical

wave can pass through the potential barrier with the superluminal speed^[15-18]. Experimental examinations to Bell's inequalities are another important advances^[19-23]. Nowadays, physicists have generally accepted the violations of Bell's inequalities as experimental facts. These experiments show that the predictions of quantum mechanics are correct; intrinsic dependences and correlations against Einstein's locality principle do exist among space-like separated events. Hence, these experiments are called distant-correlation experiments. Bell^[24], d'Espagnat^[25], Bohm^[10], Stapp^[8] have considered that we should accept the concept of the superluminal correlations or superluminal signals. Popper and Bell^[24] *et al.* asserted that the most reasonable way to interpret the distant-correlation experiments would be to return to the ether hypothesis and Lorentz's space-time theory.

2 Basic Postulates

Since many famous physicists have put forward the proposal of restoring the ether hypothesis and admitting the existence of an absolute reference frame, to investigate what results can be logically gained from the postulate of the absolute reference frame is undoubtedly meaningful. However, the results gained purely from this postulate are very limited. Please notice that the postulate of the constancy of the average circulation speed of light has firmer experimental bases and is nothing but summation of a great deal of experimental facts. Hence, in my view, the following two basic postulates can be taken as the logical starting point for constructing a new space-time theory.

Postulate 1: the principle of the absolute reference frame

There exists a preferred inertial reference frame called the 'standard inertial frame' or 'absolute inertial frame', in which space appears to be isotropic. The length contraction of a body moving with respect to the standard frame (if it exists) takes place only in the direction of the body motion and has its absolute meaning. A reference frame that moves uniformly in a straight line with respect to the standard inertial frame is also an inertial reference frame.

Postulate 2: the principle of the constancy of the average circulation speed of light

In any inertial reference frame, the average circulation speed of light signal propagating (in vacuum) over a closed path is always a constant c , and is independent of the light