Theory of Analytical Space-Time (I)

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Introduction

This is a new and fundamental theory of physics established on two hypotheses as principles: **The area of space-time is invariant (Principle of a string) and any two coordinates with relative speed would deflect each other**. The theory completes Lorentz transformation with a factor of two-dimensional or multi-dimensional rotation, obtains a new expression of astro-body precession angular speed, gives two forecasts, demonstrates Schrödinger equation with space-time rotation and concludes a space-time wave panorama for Newtonian space, Relativistic space, quantum space and black-holes. These pages show the course of the basic math expressions that include or unify the foundations of Special Relativity, General Relativity and Quantum Mechanics.

The format of this course is not only for professional people but also for those who are interested in theoretical physics. All references can be found in university physics textbooks.

What humans initially studied about the frame of space-time in science began in 1905 when the Special Theory of Relativity (STR) was established. STR first pointed out that **observers of any two different coordinates who described "an event" such as time and space would get different results,** which represented a breakthrough of the knowledge of space-time in human history. STR has opened out the relation among space, time and motion. Having put gravitational field and space-time geometry together, Einstein later set up General Theory of Relativity (GTR), which brought about an argument that all substantial movement was related to gravitational field and that we lived in a space of Riemann. Some experiments made by scientists in recent decades have shown that the judgments of GTR are correct. All of us esteem the profound thinking by Einstein in learning and studying Theory of Relativity and appreciate his contribution to modern physics.

As for development and innovation of theory of time-space, it is a pity that since the establishment of GTR, although study on space-time has made some progress in quantum theory, we are still puzzled with the complicated problems of space-time frame. What is more perplexing, up till now, is that we do not know much about the foundation of the "Space-time edifice".

After years' study, we have found that the Theory of Relativity has described only a part of space-time and that Lorentz transformation even has theoretical defects, and we can not get right answers on the issues of space-time frame based upon the Theory of Relativity only:

1. What is the physical meaning of the contraction factor $\sqrt{1-v^2/c^2}$ in STR?
2. In Lorentz transformation, on what basis is the judgment of $y = y'$ and $z = z'$ (y and z are orthogonal to relative velocity)?
3. Is there possibly another theoretical explanation for red shift?
4. Whether do observers of two different coordinates get the same result in describing **relative velocity,** or not?
5. Mercury orbital perturbation is due to its movement along a shortest route (geodesic) on bent space, then, how does gravitation make space bent? What is the essential reason for the phenomenon?
6. Is there a general solution for gravitational equation of metric tensor ($g_{\mu\nu}$) and under what

condition is the solution unique?

7. Assuming that a train moves forward at a high speed v_1, an automobile on the train moves at speed v_2 relative to the train, and, in the meantime, an object is cast from the automobile at speed v_3 relative to the automobile, how to express the movement of the object? If the automobile moves in acceleration and the cast object moves at an angle b from the direction of v_1 or v_2, then how could its movement equation be set up?

Obviously, the explanations for all the questions above are beyond what the Theory of Relativity concerns. In order to get right answers, we have to build a new space-time system to surpass the range of Relativity extensively, summarize different states of space-time and make the Theory of Relativity a special case of the new one and finally include quantum mechanics seamlessly.

We now introduce a new space-time theory to you:

Chapter 1

Establishment of Theory of Analytical Space-Time (TAST)

1.1 Foundation of the theory

Definition: Given two right-angled coordinates (S') and (S), (S') is the moving coordinate and (S) is the observing coordinate. l' and t' in (S') indicate length and time upon the condition that (S') is in a stationary state relative to (S). If there is a relative motion between (S') and (S), we, being in (S), measure l' and t' in (S'). The result of measurement is l and t, so l and t are all measured data.

Two hypotheses for TAST:

(I) Principle of invariant space-time area (**Principle of a string**)-- Product of length l' and time t' in (S') and product of l and t in (S) are called space-time area S' and S respectively. The space-time area is invariant whether there is a relative motion between (S') and (S) or not. For any (l', t'), it must meet the equation: $l'\,t' = l\,t$

What is said above can be stated in analytical geometry: If there is one point (l_1', t_1') in (S'), there must be at least another point (l_1, t_1) in (S) that makes the equation

$l_1'\,t_1' = l_1\,t_1$ tenable, see Fig 1-1.

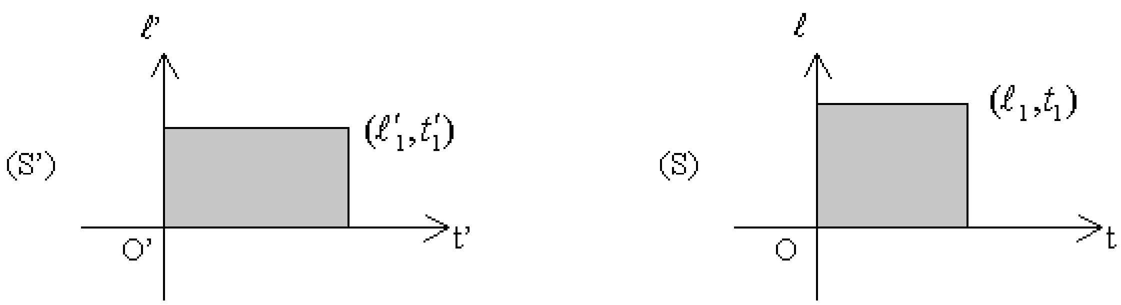

Fig 1-1

(II) Principle of space-time deflection -- if a moving coordinate (S') leaves or approaches the observing coordinate (S) with speed *u* (or *u'*), (S') deflects (S) from the direction of *u* (or *u'*), and the angle *q* of deflection or rotation results from the relative motion and its sine is proportional to relative speed *u*.

Therefore

$\sin q = u/c$ or $\sin q = u'/c'$ (*c* is speed of light.)

Fig. 1-2 shows the deflection between (S') and (S) when both origins of the coordinates coincide.

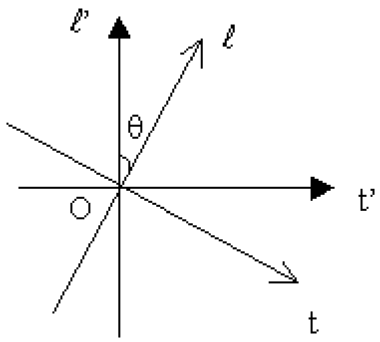

Fig 1-2

According to principles **(I)** and **(II)**, we can find the space-time relation between (S') and (S):

Given that the origins of (S') and (S) coincide, see Fig. 1-3, the relative speed is *u***,** and that *l* is in the same direction as *u***,** as per principle **(II)**, the deflection between (S') and (S) occurs:

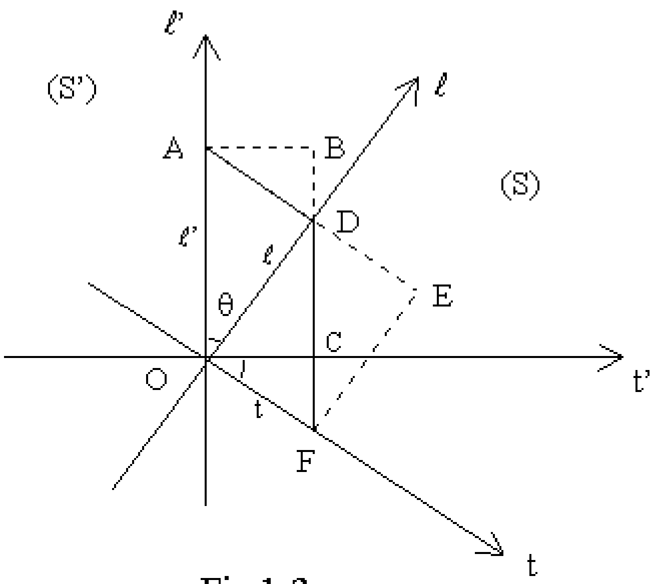

Fig 1-3

We get the results from Fig. 1-3:

$OD = OA\cos q$

Let $OD = l$ and $OA = l'$,

then $l = l'\cos\theta$ (1-1)

And from principle **(I)**, space-time area S'_{ABCO} equals to S_{DEFO} ,

so $t\,l = t'l'$, $t = t'(l'/l)$,

then substituting formula (1-1) for above,
we get $t = t'/\cos\theta$ (1-2)

And with principle (**II**): $\sin\theta = u/c$,

$$\therefore \quad \cos\theta = \sqrt{1-\sin^2\theta}$$

$$\cos\theta = \sqrt{1-(u/c)^2}$$

then (1-1) and (1-2) are as follows:

$$l = l'\sqrt{1-u^2/c^2} \qquad \textbf{(1 - 3)}$$

$$t = t'/\sqrt{1-u^2/c^2} \qquad \textbf{(1 - 4)}$$

Figure 1-3 shows the expression $\cos\theta = l/l' = t'/t$, in which the θ is just the θ in principle (II) $\sin\theta = u/c$. Formulas (1-3) and (1-4) are the basic equations of STR. Here we know that there is a definite meaning of the contraction factor: the deflection factor of space-time. It is the deflection or rotation of space-time that causes the contraction of a moving ruler and the delay of a moving clock.

The speed relation between (S') and (S) is as follows: (non-coordinate relation)

According to formula (1-1): $l = l'\cos\theta$,

we take l_1 and l_2 $(l_1 \neq l_2)$

then $l_1 = l'_1\cos\theta$ and $l_2 = l'_2\cos\theta$

$l_2 - l_1 = (l'_2 - l'_1)\cos\theta$

$\Delta l_{21} = \Delta l'_{21}\cos\theta$ (1-5)

When $\Delta l_{21} \to 0$,

$dl = dl'\cos\theta$ (1-6)

In the same way, from formula (1-2) we can get:

$dt = dt'/\cos\theta$

dt'/dt = cos$q$ (1-7)

so in formula (1-6), differentiating time t

dl/dt = cos$q$ dl'/dt

substituting formula (1-7) for above

$$\frac{dl}{dt} = \cos\theta \frac{dl'}{dt'}\frac{dt'}{dt}$$

$$dl/dt = \cos^2 q\, dl'/dt'$$

$$\therefore\ u = u'\cos^2 q \qquad (1\text{-}8)$$

when u and u' are in opposite direction,

$$u = -u'\cos^2 q \qquad (1\text{-}9)$$

Formulas (1-8) and (1-9) indicate that speed u in (S) corresponds to speed u' in (S') when there is a relative motion between (S') and (S).

1.2 Coordinates transformation

As stated at the beginning of this Chapter that there are theoretical incompleteness in Lorentz transformation, the discussion on what kinds of defects there are in Lorentz transformation is as follows:

It is known that the following two formulas (1-10) and (1-11) are basic equations of Lorentz transformation and all results are derived from the joint equations of formulas (1-10) and (1-11):

$$\begin{cases} x = ut + x'\sqrt{1-u^2/c^2} & (1\text{-}10) \\ x' = x\sqrt{1-u^2/c^2} - ut' & (1\text{-}11) \end{cases}$$

Formula (1-11) is a result of exchanging the variables with a prime (') with the variables without a prime in (1-10) and $u = -u'$. In textbooks, u is generally substituted with $-u$. Lorentz transformation never explains why $u = -u'$ because all of us think $u = -u'$ is a common sense.

It seems no problem at all on above equations, however we write down the two equations like this:

$$\begin{cases} x = ut + x'\cos\theta & (1\text{-}12) \\ x' = x\cos\theta - ut' & (1\text{-}13) \end{cases}$$

where

$$\cos\theta = \sqrt{1-u^2/c^2}$$

Multiplying (1-13) by cos$q$ and rearranging the two equations:

$$\begin{cases} x'\cos\theta + ut = x & (1\text{-}14) \\ x'\cos\theta + ut'\cos\theta = x\cos^2\theta & (1\text{-}15) \end{cases}$$

substituting formula (1-2) $t' = t \cos q$ for (1-15), and (1-14) minus (1-15)

then $ut - ut \cos^2 q = x - x \cos^2 q$

$ut(1 - \cos^2 q) = x(1 - \cos^2 q)$

therefore $x = ut$ or $t = x/u$

This is the solution of above equations, however it is useless to us. We can also get some other solutions including Lorentz transformation from joint equations (1-10) and (1-11).

Applying mathematical method of the system of linear equations, we find the rank of the equations is less than its dimension, i.e. r < n. So there are unlimited solutions for joint equations (1-10) and (1-11). Therefore, the completeness of Lorentz transformation may be doubtful. After careful analyses, a definite conclusion is worked out:

- All equations in Lorentz transformation are approximate expressions.
- In Lorentz transformation, the term *ut'* in formula (1-11) has different units between *u* and *t'*, and the product of *ut'* can not express the distance of the origins of both coordinates, therefore the expression of formula (1-11) is inaccurate and imperfect.
- It is not quite right to regard relative velocity to be equal for different coordinates. In Lorentz transformation, the expression $u = -u'$ is a wrong conception. In the state of low relative speed ($u \ll c$), *u* and *u'* are approximately equal.

As for the issue of relative velocity, we have to give a further explanation here. For example, if one train moves at speed 80 km/h, two observers, one on the train and the other on the ground, deem it is the relative speed between the train and ground. But things is not as simple as we think to be. We may set up a coordinate on the ground so the train moves away at speed of 80 km/h, and we also set up a moving coordinates on the train. The observer on the train says that the station on the ground retreats at speed of 80 km'/h'. The key point here is whether m/h equals m'/h', or not? i.e. Are the ruler and clock on the train to measure the speed equal to those on the ground? Because we live in a low-speed world, we feel no difference on velocity in different coordinates and we can't find a coordinate at so high a speed that it could make us tell this difference. Comparing to light speed, the physical speed around us is very small, so we unconsciously get the conclusion $u = -u'$ which indicates that observers both on the train and on the ground use the same scaled ruler and clock. Absolutization of relative velocity is obviously the product of low-speed-thinking. Actually, with Lorentz transformation, we have been aware that it is inapplicable to simply use resultant motion ($v_a = u_e + v_r'$) when drag velocity u_e is not much lower than light speed. On the issue of drag motion, Lorentz transformation does not totally cast off the conception of low-speed-thinking because of the fact that it is more difficult to imagine why $u \neq -u'$. In general, **observers of different coordinates who describe "an event" such as time, space (including point), velocity, acceleration, etc. will get different results. There are no absolute time, space, velocity and acceleration (or anything), nor is drag motion.** Since drag motion is a velocity **u** measured in a coordinate (S), why must it be equal to **u**' that is measured by the observers of a moving coordinate (S')? Why do we give drag motion such a preferential treatment of absoluteness? The conclusion we have here is because the moving coordinate (S') deflects the observing coordinate (S), and not only do we realize that time and space have been changed, but also space-time actually deflects them all. We have to admit that 'relative velocity' **u** and **u'** have different directions of their own, so it needs to add a deflection coefficient $\cos^2 q$ to link *u'* to *u*. (i.e. $u = u'\cos^2 q$). Another important reason to explain why $u \neq -u'$ is its physical dimension. Since u and u' have different unit dimensions or derived units (m/s , m'/s'), how can we make them equal to each other without converting their units?

We should rectify Lorentz transformation (1-12) and (1-13) as follows:

$$x = ut + x' \cos\theta \qquad (1\text{-}16)$$

$$x' = x\cos\theta + u't' \qquad (1\text{-}17)$$

From (1-17), we get: $x = (x' - u't')/\cos\theta$

substituting above for (1-16)

then $t = (x'\sin^2\theta - u't') / u\cos\theta$

differentiating x and t

$$dx = (dx' - u'dt') / \cos\theta$$

$$dt = (dx'\sin^2\theta - u'dt') / u\cos\theta$$

$$\frac{dx}{dt} = \frac{dx' - u'dt'}{dx'\sin^2\theta - u'dt'} \cdot u$$

$$= \frac{\frac{dx'}{dt'} - u'}{\frac{dx'}{dt'}\sin^2\theta - u'} \cdot u$$

From (1-9): $u = -u'\cos^2\theta$

and with principle(**II**): $\sin\theta = u'/c'$,

substituting them for above formula:

$$v = \frac{v' - u'}{v'\frac{u'^2}{c'^2} - u'} \cdot (-u'\cos^2\theta)$$

$$v = \frac{v' - u'}{1 - \frac{u'v'}{c'^2}} \cdot \cos^2\theta \qquad (1\text{-}18)$$

From formula (1-18) we can see: When $u = -u'$ and $\cos\theta = 1$, we'll come back to Lorentz transformation, which is an approximate expression of formula (1-18).

From (1-18), we get equation about v'

$$v' = \frac{v-u}{1-\frac{uv}{c^2}} \cdot \frac{1}{\cos^2\theta} \qquad \textbf{(1-19)}$$

Formulas (1-18) and (1-19) look like Lorentz transformation, but they indicate more information. For instance, when relative speed u' equals to light speed and space-time reflects by 90 degree (cos$q$ =0), we can see nothing moving in (S') including light. In this case, (S') is obviously the state of 'black-hole" so-called 'singular point' of space-time.

Now let us study coordinate transformation of (S') and (S):

When there is a relative speed between (S') and (S), u and y are in the same direction, and let both origins coincide, according to principle **(II)**, (S') deflects from (S) and the space coordinates (o-xy) and (o'-x'y') deflect each other by an angle q, see Fig 1-4. As for the rotating formula of right-angled coordinates:

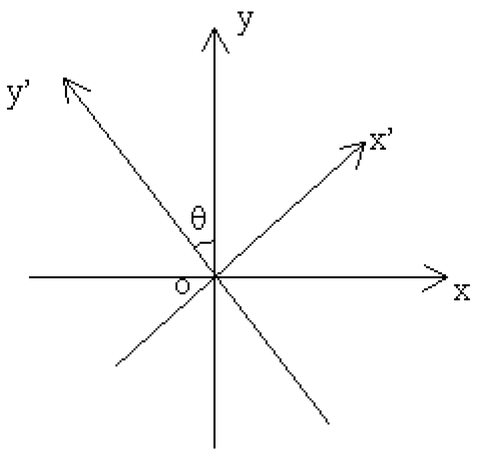

Fig 1– 4

$x = x'\cos q - y'\sin q$ (1-20)

$y = x'\sin q + y'\cos q$ (1-21)

(1-20) and (1-21) are space expressions of (S') and (S).

In (1-21), let $x' = c't'$, with principle (**II**) $\sin q = u'/c'$,

then $y = y'\cos q + u't'$

$$y = y'\sqrt{1-u^2/c^2} + u't' \qquad \textbf{(1-22)}$$

If we change y, y' into x, x' in (1-22), the formula will be the same as Lorentz transformation formula (1-10). The only difference between both is the description of relative space or distance of both origins.

As you may note $x \neq x'$ in (1-20), it means the length orthogonal to velocity u will change along with the relative speed. In Lorentz transformation, $y = y'$, $z = z'$ (Where x is identical to y and z and all of them are orthogonal to u.) is also not correct, because it is based on our daily experiences and lack of theoretical foundation.

Lorentz transformation does not deal with the concept of deflection though it indirectly uses the rotation concept in formula (1-10). To normalize space-time frame, we conclude that Galilean transformation is zero-dimensional rotation (non-rotation) and that Lorentz transformation belongs to one-dimensional rotation, whereas TAST includes two-dimensional or multi-dimensional rotation. Especially in a high speed, Galilean transformation is inapplicable and we should not use the concept of $0.9c + 0.9c$ to express this case in Lorentz transformation because of space-time deflection effect. In this case, the velocity in the moving coordinate (S') would be $0.9c'$, which is far lower than $0.9c$ in original direction.

On the following, we will get speed expression of (S') and (S) in two dimensions:

From formulas (1-20) and (1-21):

$$x = x'\cos q - y'\sin q$$

$$y = x'\sin q + y'\cos q$$

differentiating above two formulas:

$$\begin{cases} dx = dx'\cos\theta - dy'\sin\theta \\ dy = dx'\sin\theta + dy'\cos\theta \end{cases}$$

and differentiating t:

$$\frac{dx}{dt} = \frac{dx'}{dt}\cos\theta - \frac{dy'}{dt}\sin\theta$$

$$\frac{dy}{dt} = \frac{dx'}{dt}\sin\theta + \frac{dy'}{dt}\cos\theta$$

$$\begin{cases} \dfrac{dx}{dt} = \dfrac{dx'}{dt'}\cdot\dfrac{dt'}{dt}\cdot\cos\theta - \dfrac{dy'}{dt'}\cdot\dfrac{dt'}{dt}\cdot\sin\theta \\ \dfrac{dy}{dt} = \dfrac{dx'}{dt'}\cdot\dfrac{dt'}{dt}\cdot\sin\theta + \dfrac{dy'}{dt'}\cdot\dfrac{dt'}{dt}\cdot\cos\theta \end{cases}$$

with $dt'/dt = \cos q$, then

$$\begin{cases} v_x = v'_x\cos^2\theta - v'_y\sin\theta\cdot\cos\theta & \text{(1-23)} \\ v_y = v'_x\sin\theta\cdot\cos\theta + v'_y\cos^2\theta & \text{(1-24)} \end{cases}$$

Formulas (1-22) and (1-23) are speed expression of two-dimensional rotation, which is demonstrated by way of geometry. Now we confirm it again with the method of vector.

Supposing radius vector of (S): $\vec{\mathbf{r}} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$

Radius vector of (S'): $\vec{\mathbf{r}}' = x'\mathbf{i}' + y'\mathbf{j}' + z'\mathbf{k}'$ $\quad (\vec{\mathbf{r}}_0 = 0)$

With formula (1-5):

$$\Delta l_{21}=\Delta l'_{21}\cos q$$

$$\vec{\mathbf{l}}_{21} = \vec{\mathbf{l}}'_{21}\cos\theta$$

It can be written like this: $\vec{\mathbf{r}} = \vec{\mathbf{r}}'\cos\theta$

$$\because \quad \vec{\mathbf{v}} = \frac{d\vec{\mathbf{r}}}{dt} = \frac{d\vec{\mathbf{r}}'}{dt}\cdot\cos\theta$$

$$= \cos\theta\cdot\frac{d}{dt}(x'\mathbf{i}' + y'\mathbf{j}' + z'\mathbf{k}')$$

$$= \cos\theta\left(x'\frac{d\mathbf{i}'}{dt} + y'\frac{d\mathbf{j}'}{dt} + z'\frac{d\mathbf{k}'}{dt} + \frac{dx'}{dt}\mathbf{i}' + \frac{dy'}{dt}\mathbf{j}' + \frac{dz'}{dt}\mathbf{k}'\right)$$

$$= \cos\theta\left[x'\left(\vec{\omega}\times\mathbf{i}'\right) + y'\left(\vec{\omega}'\times\mathbf{j}'\right) + z'\left(\vec{\omega}'\times\mathbf{k}'\right) + \frac{dx'}{dt'}\frac{dt'}{dt}\mathbf{i}' + \frac{dy'}{dt'}\frac{dt'}{dt}\mathbf{j}' + \frac{dz'}{dt'}\frac{dt'}{dt}\mathbf{k}'\right]$$

(Derivation of above formulas refers to the unit vector differential coefficient formula.)

$$\vec{\mathbf{v}} = \left(x'\omega_z'\mathbf{j}' - y'\omega_z'\mathbf{i}'\right)\cos\theta\sin\theta + v_x'\mathbf{i}'\cos^2\theta + v_y'\mathbf{j}'\cos^2\theta$$

$$\vec{\mathbf{v}} = \left(v_x'\cos^2\theta - v_y'\cos\theta\sin\theta\right)\mathbf{i}' + \left(v_y'\cos^2\theta + v_x'\cos\theta\sin\theta\right)\mathbf{j}'$$

$$\because\ \vec{\mathbf{v}} = v_x\mathbf{i} + v_y\mathbf{j} + v_z\mathbf{k}$$

$$\therefore \begin{cases} v_x = v_x'\cos^2\theta - v_y'\cos\theta\sin\theta \\ v_y = v_y'\cos^2\theta + v_x'\cos\theta\sin\theta \end{cases}$$

We see that the result above is the same as formulas (1-23) and (1-24).

TAST tells us that light speed is the speed limit to the show of what we observe instead of to how it is really moving! This conclusion is deferent from the assertion by STR that light speed is the limit of motion of anything.

We can not fix the direction of the deflection by observing an object at very high speed and this is related to quantum uncertainty and non-locality. Please refer to next Chapter. Space-time deflection or rotation may help us clarify our perplexing concepts among observation, measurement, objective, subjective, phenomena, reality and existence in physics in the end.

1.3 TAST for non-inertial system

With the two principles, we have discussed the expression of space-time in the scope of STR. In non-inertial system, however, when relative speed becomes variable, the principles (**I**) and (**II**) are still applicable. Accordingly, it is necessary for us to refer to GTR. Though the issue of gravitational field is only a part of non-inertial system, we emphasize it as a major study:

1.3.1 Red shift of the sun and other stars

It is known that the revolution speed of planets round the sun in the solar system can be educed from the Law of Gravity and the Second Law of Newton:

$$v = \sqrt{\frac{GM_s}{R}}$$

M_s: mass of the sun

R: distance between a planet and the sun

Supposing planet X_S goes round the sun, its speed will be:

$$v_s = \sqrt{\frac{GM_s}{R_s}}$$

R_s: radius of the sun

v_s: non-locus speed of the planet

If we set the observing system (S) on the earth and the moving system (S') on planet X_S, (S') has a relative speed u to (S), and $u=v_s$.

According to formula (1-24):

$$v_y = v_x' \sin\theta\cos\theta + v_y' \cos^2\theta$$

$$\because \quad v_x' = 0$$

$$\therefore \quad v_y = v_y' \cos^2\theta = v_y'(1 - u^2/c^2)$$

$$\frac{v_y' - v_y}{v_y'} = \frac{u^2}{c^2}$$

Let $v_y' - v_y = \Delta v$

Δv means the speed difference for a velocity described by (S') and (S).

$$\frac{\Delta v}{v_y'} = \frac{u^2}{c^2}$$

And let $v_v' = c$, then $\Delta v = \Delta c$

$$\therefore \quad \frac{\Delta c}{c} = \frac{u^2}{c^2} \qquad (1-25)$$

$$\because \quad \frac{\Delta c}{c} = \frac{\Delta \nu \lambda}{\nu_c \lambda} = \frac{\Delta \nu}{\nu_c}$$

Where ν and λ are frequency and wavelength of light respectively.

$$\therefore \quad \frac{\Delta \nu}{\nu_c} = \frac{v_s^2}{c^2} = \frac{GM_s}{R_s c^2} \qquad (1-26)$$

Formula (1-26) is the same as that in GTR about red shift and its calculated value is:

$$\frac{\Delta \nu}{\nu_c} = 2.12 \times 10^{-6}$$

Formula (1-26) indicates that red shift would be much bigger if the density of a star is very great. This means red shift is also related to the density of stars. The factor that influences red shift is beyond Doppler effect.

1.3.2 Light 'bent' in gravitation field

Light would curve in gravitational field -- The prediction by GTR was demonstrated in experiments. We now reconfirm it with TAST:

From formula (1-25):

$$\frac{\Delta c}{c} = \frac{u^2}{c^2}$$

Let $\sin\alpha = \Delta c/c$, angle α is the deflection of light:

$$\sin \alpha = \frac{u^2}{c^2} \qquad (1-27)$$

We can get the deflection angle of sun-light with formula (1-27):

$$\sin \alpha_s = \frac{v_s^2}{c^2}$$

When α_s is very small,

$$\alpha_s = \frac{GM_s}{R_s c^2}$$

Since α_s is too small to observe, we survey the deflection of another star when eclipse occurs. If the star we observe is similar to the sun in stability and approximately as dense as the sun, the light of this star would deflect as shown in Fig. 1-5.

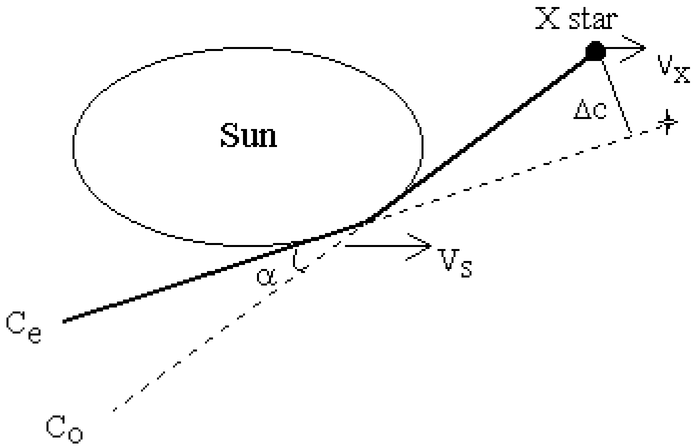

Fig 1-5

$$\sqrt{\frac{GM_s}{R_s}} \cong \sqrt{\frac{GM_x}{R_x}} \qquad \therefore v_s \approx v_x$$

With formula (1-27)

$$\sin\alpha = \frac{u^2}{c^2}$$

and $u = v_s + v_x$

$$\sin\alpha = \frac{(v_s + v_x)^2}{c^2} \qquad (1-28)$$

$$\alpha_x = \frac{(2v_s)^2}{c^2} = \frac{4v_s^2}{c^2}$$

$$\therefore \alpha_x = 4\frac{GM_s}{R_s c^2} \qquad (1-29)$$

The deflective angle α_x is not merely caused by solar gravitation and actually it is the sum of deflective angle of the sun and the star and caused by the sun-star system that has a non-locus speed

($u = v_s + v_x$) relative to observers on the earth. It should be said that the essence of 'light bent' is light deflection indeed. Formula (1-29) is the approximation of (1-28). For a white dwarf, its deflection angle can be figured out with formula (1-28).

1.3.3 Mercury orbital perturbation

General Relativity has given out the expression of perihelion precession of mercury by Schwarzschild solution and solved the surplus precession of Mercury orbit:

$$\Delta\varphi = \frac{24\pi^3 a^2}{T^2 c^2 (1 - e^2)}$$

The following formula (1-30) is derived from TAST (The course is skipped here.) and the calculation result meets the real facts.

$$\Delta\overline{\Psi} = \frac{\pi\bar{v}^3}{ac^2} \qquad (1 - 30)$$

$\Delta\overline{\Psi}$: average precession angular speed

$\bar{v}$: average speed of Mercury orbit

a : semimajor radius of Mercury orbit

With the formula (1-30), we can figure out the precession angular speed of Mercury orbit to be 43.08" per century. It can be also used to calculate the precession angular speed of Venus, the Earth and other planets.

Apart from planetary orbital perturbation in solar system, there are other perturbation phenomena in binary-star system. Two astronomers, E. F. Guinan and F. P. Maloney, in Villanova University of USA in 1985 found that the accumulated precession angular of the binary star DI Her in 84 years was much lower than the calculated amount with GTR. Astronomers could hardly find out a fair explanation for the fact. We can use formula (1-30) to solve this problem, getting 0.66 degree, so closely matching 0.64 degree of the observed fact, compared with 2.34 degree calculated with GTR [Edward. F. Guinan and Frank. P. Maloney *Astronomical Journal* v 90 (1985) p 1519].

We have discussed red shift in GTR, Light bent in gravitation field and Mercury orbital perturbation. So far we have answered some questions mentioned at the beginning of this Chapter and hope that you have briefly understood TAST.

Space-time frame is one of most important concepts in physics and all our basic physical concepts such as continuity, discrete, fluctuation and so on are established on it. We will discuss it as well as metric tensor ($g_{\mu\nu}$) in gravitational field of GTR in a later Chapter.

You may notice that the two principles **(I)** and **(II)** of the new theory do not deal with the basic principle of invariant light speed, but the results we have got are the same as those from GTR. Actually, it is the principles **(I)** and **(II)** that sum up the principles of general covariance and invariant of light speed and open out the inner-contact of space-time more widely and deeply.

1.4 Forecasts

As for the establishment of the new and fundamental theory, it is insufficient to demonstrate what have been concluded, we need to (or must) bring forward some new and unidentified inferences or forecasts as follows to confirm the correctness of the principles **(I)** and **(II)** .

1.4.1 0.71c space-time light cone vertex

From two-dimensional space-time expression (1-20),

$x = x'\cos q - y'\sin q$

let $x' = y' = c't'$

then $x = c't' (\cos q - \sin q)$

and let $x = 0$ and $t' \neq 0$

then $\cos q - \sin q = 0$; $\mathrm{tg}\, q = 1$, $q = \pi/4$

$$\because \cos\theta = \sqrt{1 - u^2/c^2}$$

$$\therefore \quad u = \frac{\sqrt{2}}{2} c \approx 0.71c$$

The result shows that x orthogonal to the leaving velocity u will become null when relative speed is $0.71c$ (q = 45 degree). The significance of space-time here is that anything that has relative speed $0.71c$ to us is invisible even though it moves in front of our eyes. The object can appear again from its rear side when relative speed $u > 0.71c$. This forms a phenomenon of light cone whose vertex point is $0.71c$ and it may be demonstrated by measuring moving particles in lab.

It is an amazing fact referring to this inference: Anything, no mater how big or small, will have no barrier in space as long as it reaches the relative speed of $0.71c$ (or in a state of 45 degree of deflective or rotational angle of space)!

Ever thought about material or body fax?

1.4.2 Deflection of space-time results in double refraction of light

Under the deflection of space-time, we know that time, space, velocity, etc. would change. What about light then? Can we say light speed is unchangeable in vacuum?

We conclude that light from a moving system will produce a phenomenon of double refraction. Light will split into two rays: one is ordinary ray c_o and the other is extraordinary ray c_e.

c_o spreads with the same speed in all directions and follows the law of refraction whereas c_e goes with a speed that is changeable in different directions and varies on the relative speed of a moving system and does not follow the law of refraction.

Speed formula of extraordinary ray c_e is as follows:

With (1-18),

$$v = \frac{v' - u'}{1 - \frac{u'v'}{c'^2}} \cos^2 \theta$$

Let $v' = c'$ represent the measured speed of light in (S'),

$$v = \frac{c' - u'}{1 - \frac{u'}{c'}} \cos^2 \theta = c' \frac{1 - \frac{u'}{c'}}{1 - \frac{u'}{c'}} \cos^2 \theta = c' \cos^2 \theta$$

Let $c' = c$, then

$$v = c\cos^2 q \qquad (1\text{-}31)$$

Referring to formula (1-31), v is c_e;

then $c_e = c\cos^2 q$

$$c_e = c(1 - u^2/c^2) \qquad (1\text{-}32)$$

In formula (1-32), $c_e < c$ means not all light speed is invariant. This conclusion is challenging the principle of invariant light speed. Another thing we have to know is the angle between c_e and c_o shown in formula (1-28) and Fig. 1-5. In addition, c_e does not show the event of red shift and c_o is always red shifted in spectrum.

The things left to us are to identify the existence of c_e and see if c_e is less than light speed c or not.

- To measure a star's ray when eclipse, we can obtain its speed c_e from following formula:

$$c_e = c(1 - 4\frac{GM_s}{R_s c^2})$$

(Under such a condition, observed c_e should be 1/100000 lower than c.)

- If getting enough measuring precision, we may use a satellite or a space shuttle mounted with a laser reflecting set to measure the speed difference between c_e and c. There is another way to find the existence of c_e according to the principle of ellipse polarization.

Besides $u = -u'\cos^2 q$, the two forecasts above or other direct inferences from TAST will validate the principles (**I**) and (**II**), and at meantime they are a quite checkup for TAST, so we look forward to experimental results.

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Theory of Analytical Space-Time (II)

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For thousands of years, it has long been considered that what we see or observe is objective reality, however the impersonal world is in existence without relying on our consciousness. In 1905, Einstein rose in revolt first. He pointed out that, according to the Principle of constancy of light velocity, the length of an object in the direction of its movement looked shorter when relative speed of the object was high enough. Subauditionally, if we make two rulers of same length on the earth and put either of them in an airship that leaves the earth at an ultra high speed, we will find that the ruler on the airship is shorter than the other left behind on the earth. A philosophic problem here occurs: Is the length of the ruler objective on the airship? What is the standard of objective reality, stationary state or movement state? Einstein did not give a sound philosophic explanation.

Theory of Analytical Space-time (TAST) states that all facts we have observed may not be their real existence or objective matter in physics. Real existence is absolute but the result of observation is relative. 'Objective existence' as we are used to thinking about is nothing but misunderstanding of objectivity and it depends upon the state of observers. The faster an object moves, the greater difference it has between real existence and result of observation. Deflection of space-time allows us to know the difference.

When the airship is stationary, we say the real length of the ruler is the same as its measured length, however as long as the airship leaves the earth with a high speed, we can find there is error between its real length and measured length. Furthermore, this error will become bigger with the increase of speed of the airship. Due to the deflection of space-time, the real length of the ruler can not be measured precisely. We therefore use mathematical language to explain what uncertainty effect is both in microcosm and macrocosm.

It is known that uncertainty effect takes place in measurement of microcosm. What is the cause?

When an object leaves the earth with a very high speed u, with formula (1-1): $l = l'\cos q$, l, l' are measured length and real length respectively, the error between l and l' is shown as d,

$$d = l' - l = l' - l'\cos q = l'(1-\cos q) \qquad (2\text{-}1)$$

If measured length and real length of the object are near or equal,

then $d \to 0$ and $(1-\cos q) \to 0$ or $(1-\cos q) = 0$,

since $\cos q = (1-u^2/c^2)^{1/2}$, we must have $u \to 0$ or $u = 0$.

Apparently, this result does not agree with the assumed condition at the beginning.

Therefore, we conclude that the real length or position of an object could never be made certain by observation when the object is in a high relative speed. There is a same situation to momentum. The higher the relative speed of an object is, the more it shows uncertainty. From Chapter 1, we know that the measuring results are relative in a high speed situation, but few of us are often aware that the units we use to measure are absolute! Since uncertainty results from the deflection or rotation of space-time, we naturally infer that quantum uncertainty is due to space-time rotation and we can further understand the cause of quantum uncertainty in the paragraphs below. It can be said that uncertainty both in microcosm and macrocosm results from the deflection or rotation of space-time! TAST has expanded the concept of uncertainty and uncertainty effect is not the 'patent' of microcosm. It resides in superposition, depending on the method of measurement. For example, we are never certain in what direction the deflection or rotation is in three-dimensional space until a measurable impact acts on the object. Then, what about observation? Philosophically, perceptive existence is hardly the same as real existence and we should not request 'two existences' to be unified. Only on admitting objectivity of 'two existences' can we stride a firm step in searching for so called 'Theory of Everything'.

Chapter 2

Quantization of Analytical Space-time & Function of Space-time Wave

2.1 Compton effect

We begin with the quantization of analytical space-time in the scope of 10^{-10} m -- 10^{-14} m.

With formula (2-1), *d* = *l'* (1-cos*q*), we introduce Compton wavelength *lc* (*lc*=*h*/*mc*=2.426 x 10^{-12} m).

Let *l'* = *lc* and put into (2-1),

then

$$\Delta\lambda = \lambda_c(1-\cos\theta)$$

$$\lambda_2 - \lambda_1 = \frac{h}{mc}(1-\cos\theta)$$

$$= \frac{2h}{mc}\sin^2\frac{\theta}{2} \qquad (2-2)$$

Formula (2-2) is the Compton math model of dispersed X-ray and the deflective angle *q* proves the same as Compton dispersion angle.

In 1923, Compton discovered that the wavelength of dispersed X-ray would augment, and thought this phenomenon was due to the collision among photons and electrons. So simply do we express the dispersion effect by deflection of space-time and get the same formula as Compton's.

2.2 Basic property of analytical space-time

Let a plane of a moving coordinate (S') be set *G'* of complex number *z'*=*x'*+***i****y'* and, at meantime, the other set *G* is complex number *w*, *w*=*u*+***i****v*

according to formulas (1-20) and (1-21):

x = *x'*cos*q* - *y'*sin*q*

$$y = x'\sin q + y'\cos q$$

Let $u = x$ and $v = y$, obviously there is a definite rule between z' and w, which makes every complex number z' in set G' correspond to the other complex number $w = u + \boldsymbol{i}v$,

$$w = (x'\cos q - y'\sin q) + \boldsymbol{i}(x'\sin q + y'\cos q)$$

We call complex number w in the observing coordinate the complex function of complex number z' in the moving coordinate as for $w=f(z')$.

For convenience, we delete all primes (′) of the terms on the moving coordinate, x' is changed to x and y' to y, namely $w=f(z)$.

$z = x + \boldsymbol{i}y$ (2-3)

or $z = re^{i\alpha}$ (2-4)

$r = (x^2 + y^2)^{1/2}$, $\arg w = \alpha$, $\mathrm{tg}\alpha = x/y$

$w = u + \boldsymbol{i}v$ (2-5)

$u = x\cos q - y\sin q$ (2-6)

$v = y\cos q + x\sin q$ (2-7)

With mapping concept of complex function, in geometry, the function $w =f(z)$ is the mapping of set G' of plane z to set G of plane w, we call z the space-time primary image and w the mirror image in physics. Space-time mirror image is determined by mapping

$$w = z_o z \qquad (2\text{-}8)$$

$$z_o = \cos q + \boldsymbol{i}\sin q$$

$$z_o = r_o e^{iq} \quad (r_o = 1)$$

$$\therefore\ w = e^{iq} re^{i\alpha}$$

$$w = re^{i(a+q)} \qquad (2\text{–}9)$$

With the definition of complex function, we know each point $z_1, z_2, \dots z_n$ in the observing coordinate (S) is mapped to $w_1, w_2, \dots w_n$ by mapping $w = z_o z$, so the plane image in the moving coordinate (S') has changed to the other geometry image of the observing coordinate (S). From (2-4) and (2-9), the difference between w and z is that w has deflected by an angle q which is the deflective angle in principle (**II**) of TAST.

To sum up the above content, we conclude several characteristics of analytical space-time in complex functions:

- Mirror image composed of $w_1, w_2, \dots w_n$ differs from primary image.
- Space-time mirror image is determined by the mapping $w = z_o z$ or $w = re^{i(\alpha+\theta)}$.

- Due to $|z_o| = 1$, space-time mirror image does not flex , but it circumvolves a phase angle *q* which is the phasic difference between the observing coordinate (S) and the moving coordinate (S').
- The phasic angle *q* is an independent variable and has nothing to do with *z*.
- Because of argument Argw=(α + *q*)+2$k\pi$, the number of mirror images is infinite.

Now let us discuss the analyzation of deflected space-time according to Cauchy-Riemann function:

$$\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y} \qquad \frac{\partial u}{\partial y} = -\frac{\partial v}{\partial x}$$

If a function *f*(*z*) is differentiable in field *D* and meets the condition above, *w*=*f*(*z*) is an analytical function in *D*.

With (2-6) and (2-7),

$$u = x\cos q - y\sin q$$

$$v = y\cos q + x\sin q$$

$$\frac{\partial u}{\partial x} = \cos\theta \qquad \frac{\partial v}{\partial y} = \cos\theta \qquad \therefore \frac{\partial u}{\partial x} = \frac{\partial v}{\partial y}$$

$$\frac{\partial u}{\partial y} = -\sin\theta \qquad \frac{\partial v}{\partial x} = \sin\theta \qquad \therefore \frac{\partial u}{\partial y} = -\frac{\partial v}{\partial x}$$

Therefore, the function of space-time mirror image *w*=*f*(*z*) is an analytical space-time function.

2.3 Quantization of Analytical Space-time

We have discussed the characters of analytical space-time in complex function and got the function (2-9) $w = re^{i(\alpha+\theta)}$, where *r* and α are constant. The deflective angle *q* is concerned with a wave vibrated in *x* direction, then *q* = *wt* , *t* = *x*/*u*, *uT* = *l*

Therefore

$$w = r_0 e^{i(\omega t+\alpha)}$$

$$w(x) = r_0 e^{i\left(\frac{2\pi}{\lambda}x+\alpha\right)} \qquad (2\text{-}10)$$

Formula (2-10) shows a wave-function under complex field. We make it twice differential:

$$\frac{dw}{dx} = r_0 i \frac{2\pi}{\lambda} e^{i\left(\frac{2\pi}{\lambda}x+\alpha\right)}$$

$$\frac{d^2w}{dx^2} = -\frac{4\pi^2}{\lambda^2} r_0 e^{i\left(\frac{2\pi}{\lambda}x+\alpha\right)} \qquad (2\text{-}11)$$

Since

$$E = h\nu, \quad P = \frac{h}{\lambda} \quad \textbf{and} \quad E_c = \frac{1}{2}mv_x^2 = \frac{P^2}{2m}$$

and

$$\lambda^2 = \frac{h^2}{P^2} = \frac{h^2}{2mE_c}$$

put into (2-11), then

$$\frac{d^2w}{dx^2} = -\frac{8\pi^2 mE_c}{h^2} w$$

and replacing w with y . Since $E = E_c + U$, we get

$$\frac{d^2\psi}{dx^2} + \frac{8\pi^2 m}{h^2}(E - U)\psi = 0 \qquad (2\text{-}12)$$

Formula (2-12) as the basic function of quantum mechanics has long been an assumptive or experiential equation, but under complex function of analytical space-time, Schrödinger wave function becomes the deduction from TAST. However it can not be regarded as a strict theoretical deduction because some basic concepts of quantum mechanics and Relativity such as $E= h\nu$, $E=mc^2$ and $E=2E_c$ are used in above deduction. Therefore it is necessary for us to review the basic concepts of quantum mechanics and Relativity from the deflection notion of analytical space-time so as to get a profound math expression -- Space-time wave function (STWF) to link Relativity up to quantum mechanics.

Assuming that one plane cosine wave travels along X axis in a non-absorbed medium, wave-speed is u and displacement of a particle is y and swing y_0, the vibration function of the particle is:

$$y = y_0 \cos w\, t \qquad (2\text{-}13)$$

According to formula (1-1), $l = l'\cos q$, replacing l and l' with y and y_0 respectively, then

$$y = y_0 \cos q \qquad (2\text{-}14)$$

On comparing (2-13) with (2-14), if q in formula (2-14) varies at a uniform angular-speed, i.e. | q

|= *wt*, cos*q*=cos(-*q*), (2-14) and (2-13) are identical. This shows that any free vibratory particle function can be expressed as the space-time wave function. In a broader view, a simple periodic motion is a form of space-time wave. Not only do we use formula (1-1) to express varieties of space for coordinates, but it also becomes the expression of transferring more information among different space-time systems by way of space-time wave.

With space-time wave function $y = y_0 \cos q$, let us see what conclusion it would give.

Speed *u* in *y* direction:

$$u = \frac{dy}{dt} = -y_0 \omega \sin \omega t \qquad (2\text{-}15)$$

According to principle (**II**): sin*q* =*u*/*c*, and putting (2-15) into it, then

$$\sin\theta = \frac{u}{c} = -\frac{y_0\omega}{c}\sin\omega t$$
$$= \frac{y_0\omega}{c}\sin(-\omega t)$$

Minus means that space-time circular frequency has a reverse direction to particle wave or the phasic difference between two circular frequencies is π while the absolute values are equal.

Let | *q* | = *wt*, then $y_0 w = c$

$$y_0 = cT/2\pi \qquad (2\text{-}16)$$

and putting (2-16) into (2-14), then

$$y = \frac{\lambda}{2\pi}\cos\theta \qquad (2\text{-}17)$$

When discussing energy of space-time wave function (STWF), we have to add a restricted condition: for observers, STWF should meet the condition $y \geq 0$, because it seems that space can not be minus. See Fig 2-1, in periods *T*, domain [0, *T*/4] and [3*T*/4, *T*] meets $y \geq 0$, correspondingly for *q*, the domain is [0, π/2] and [3π/2, 2π].

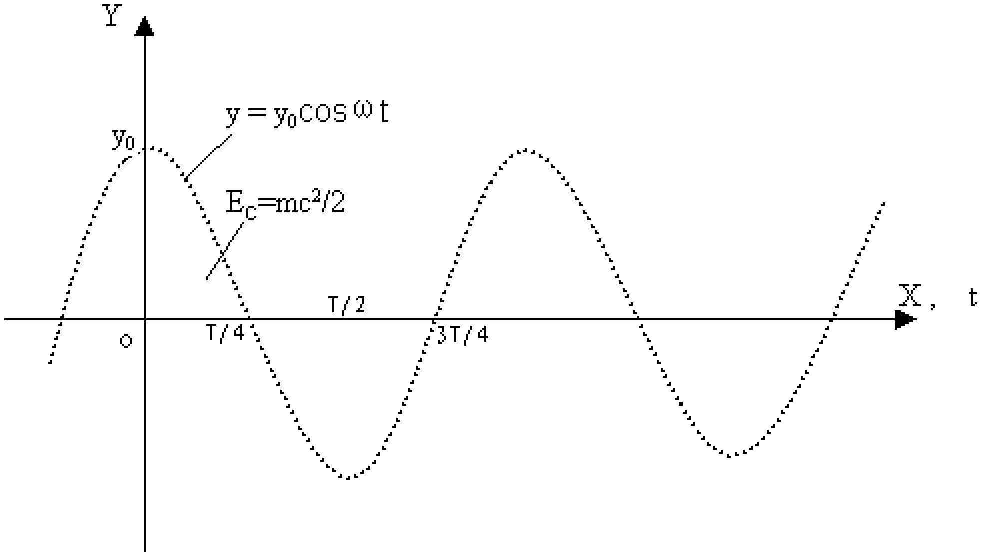

Fig 2-1

Note: $t = 0$ is a factitious or relative situation.

With (2-15) and (2-16),

$$u = \frac{dy}{dt} = -y_0 \omega \sin \omega t \qquad (y \geq 0)$$
$$= -c \sin \omega t$$

$$E = \frac{1}{2} m u^2 = \frac{1}{2} m c^2 \sin^2 \omega t \qquad (2\text{-}18)$$

Energy E in formula (2-18) is determined at time t, we need to know the sum of the energy in a period T, which is defined as quantum energy E_Q. Because of incontinuity of STWF in the domain [0, +2π], quantum energy E_Q can not be figured out by average value of $\sin^2 wt$ in domain [0, T]. Since space-time wave is elastic, we calculate its wave-power: energy at time t_1 corresponds to E_1, t_2 to E_2, then $\Delta E = E_2 - E_1$. Average rate of wave energy in Δt is $\Delta E/\Delta t$, so wave-power W at time t should be, as $\Delta t \to 0$, the limit of $\Delta E/\Delta t$.

$$W = \lim_{\Delta t \to 0} \frac{\Delta E}{\Delta t} = \frac{dE}{dt} = mc^2 \omega \sin \omega t \cos \omega t \qquad (2-19)$$

$$\sum E = \int_0^{T/4} dE = mc^2 \int_0^{T/4} \omega \sin \omega t \cos \omega t dt \qquad \left(0 \le \theta \le \frac{\pi}{2}\right)$$

$$= \frac{mc^2}{4} \int_0^{T/4} \sin 2\omega t d(2\omega t)$$

$$= \frac{mc^2}{4} \cos 2\omega t \Big|_{T/4}^{0}$$

$$= \frac{1}{2} mc^2$$

The result above shows that the sum of energy ΣE in domain [0, $\pi/2$] is $E_C = mc^2/2$ (E_C means classical energy). Quantum mechanics deals with energy in domain [0, +∞) while quantum energy E_Q is the positive sum of energy in domain [$2k\pi$, $2(k+1)\pi$] or unit positive energy in any period T. The algebraic sum of energy in any period T is null, so we can only measure positive energy anyway. The relation of E_Q and E_C is as follows:

$$E_Q = 2E_C = mc^2 \qquad (2-20)$$

Space in domain ($T/4$, $3T/4$) is minus and generally considered as a forbidden zone. As observers, we can only survey shared-energy one by one. Every share is mc^2. This phenomenon is said to be energy quantization in quantum mechanics. (Note: We see that there are exactly two periods of quantum wave in a period of space time wave or quantum spin of 2 revolutions returns to its original or starting state. Energy distribution indicated in Fig. 2-1 is just for easy understanding and it should be pointed out that there is minus energy in positive space and vice versa similar to an elastic wave. The distribution and the essence of energy of space-time will be discussed in next chapter).

The general solution of ΣE or E_Q should be:

$$\sum E = \int_0^{T} W(t) dt = \overline{W}(t) \cdot T \qquad (2-21)$$

Where $\overline{W}(t)$ is average power of wave.

With formula (2-19),

$$W(t) = mc^2\omega \sin \omega t \cos\omega t$$
$$= mc^2 (2\pi v) \cdot \frac{1}{2} \sin 2\omega t$$
$$= \pi mc^2 v \sin 2\omega t$$

Let $k = \pi mc^2 v$, then $W(t) = k \sin 2\omega t$

$$\overline{W}(t) = k \frac{2}{T} \int_0^{T/4} \sin 2\omega t dt$$
$$= \frac{2k}{T} \frac{1}{2\omega} \int_0^{T/4} \sin 2\omega t d(2\omega t)$$
$$= \frac{k}{2\pi} \cos 2\omega t \Big|_{T/4}^{0} = \frac{k}{\pi}$$

then $W(t) = mc^2 v$, put into (2-21), then quantum energy $E_Q = (mc^2 T)v$.

Let $h = mc^2 T$, so the result is $E_Q = hv$ (2-22)

Apparently, h is a constant called Planck's constant ($h = 6.63 \times 10^{-34}$ Js) and commonly used in quantum mechanics.

So far, we have got the basic energy expressions of quantum mechanics and Relativity from TAST:

$$E_Q = mc^2,\ E_Q = hv \text{ and } E_Q = 2E_C$$

Furthermore, according to STWF, we will demonstrate Schrödinger equation strictly, and make it, a 'hypothesis' in quantum mechanics, a theoretical outcome of TAST.

2.4 Space-time wave function

According to the description of space-time wave function in **2.3**, supposing space-time wave is simple periodic vibration at speed u in X direction where all matters vibrate freely. Circular frequency is w, period T, wavelength and swing l and A, so the vibration is expressed:

$$y = A\cos wt$$

Also, the complex function should be:

$$R_e(y) = Ae^{iwt}$$

where $R_e(y)$ takes the real part of the complex only. We do not discuss imaginary space-time in this Chapter.

with $w = 2\pi/T$, $t = x/u$ and $uT = l$

$$R_e(y) = Ae^{i\frac{2\pi x}{Tu}} = Ae^{i\frac{2\pi x}{\lambda}}$$

Replacing $R_e(y)$ **with** $\psi(\mathrm{x})$,

we have

$$\psi(x) = Ae^{i\frac{2\pi x}{\lambda}}$$

Differentiating x **twice,**

$$\frac{d^2\psi}{dx^2} = -A\frac{4\pi^2}{\lambda^2}e^{i\frac{2\pi x}{\lambda}} \qquad (2-23)$$

According to formula (2-20), $E_Q=2E_C$, $E_Q = mc^2$

$l = cT$, $c^2 = \lambda^2/T^2$, $E_Q = m\lambda^2/T^2$,

$\lambda^2 = E_Q T^2/m = E_Q/v^2 m$ (2-24)

and with formula (2-22) $E_Q=hv$, $v = E_Q/h$ put into (2-24), then

$$\lambda^2 = \frac{h^2}{mE_Q} \quad \text{and} \quad E_Q = 2E_c$$

$$\lambda^2 = \frac{h^2}{2mE_c} \qquad (2-25)$$

putting (2-25) into (2-23), we have

$$\frac{d^2\psi}{dx^2} = -\frac{8\pi^2 mE_C}{h^2}\cdot\psi$$

and $E= E_C +U$, where E is overall energy of mass in the space and U is potential energy.

$$\frac{d^2\psi}{dx^2} + \frac{8\pi^2 m}{h^2}(E-U)\psi = 0 \qquad (2-26)$$

Also, the function is the same in directions of y and z.

$$\frac{\partial^2\psi}{\partial x^2}+\frac{\partial^2\psi}{\partial y^2}+\frac{\partial^2\psi}{\partial z^2}+\frac{8\pi^2 m}{h^2}(E-U)\psi=0$$

$$\text{or}\qquad \nabla^2\psi+\frac{2m}{\hbar^2}(E-U)\psi=0 \qquad (2\text{-}27)$$

If we analyze *y*(*t*) of STWF from the meaning of math, the Fourier transform of *y*(*t*) is as follows:

$$G(\omega)=\int_{-\infty}^{+\infty}y(t)e^{-i\omega t}dt$$

According to energy integral of Parseval equation of Fourier transform, we get

$$\int_{-\infty}^{+\infty}[y(t)]^2dt=\frac{1}{2\pi}\int_{-\infty}^{+\infty}|G(\omega)|^2d\omega$$

where

$$|G(\omega)|^2=G(\omega)\overline{G(\omega)}=S(\omega)$$

S(*w*) is called energy density function, on which the distribution of energy *y*(*t*) depends. The sum of energy can be obtained by integral to all frequency. But as for incontinuity of *y*(*t*) in the domain, we have to use the method of statistics, which is called probability wave function in Quantum-mechanics, to determine the distribution of energy in general space.

$$\iiint|\Psi|^2dv=1 \qquad |\Psi|^2 \text{ is probability density.}$$

(Here, we will not discuss energy density function of STWF further, since Fourier transform is a math issue only.)

As formula (2-27) is a complete expression of three-dimensional space, Schrödinger equation is no longer a hypothesis and becomes a theoretical result of STWF hereon. Space-time wave has a far greater and wider significance than particle wave (vibration). No matter what mechanical vibration, electromagnetic surge or vocal wave, they are all manifestation of space-time vibration or a certain wave in special scope, all of which are general phenomena in nature of both macrocosm and microcosm, and can be expressed by STWF. Furthermore, with overlapping of space-time waves, we know that quantum phenomena including wave-particle duality result from the impact of measurement and discover what hides behind the Schrödinger equation.

It is known that a math equation in physics is indispensable to certain special physical notions, but we find that Schrödinger equation, as a principle in Quantum mechanics, is lack of a '*should have*' physics meaning. It might as well be a conclusion as a hypothesis or principle. Though Schrödinger equation is useful in application, it does have a weak foundation as the principle of Quantum mechanics before TAST shows up. Also, General Relativity defines non-inertia space-time as a space of Riemann. For Riemann space has positive curvature, we have to doubt about where the minus curvature space is. Could it be said that God favors positive curvature? We can not talk about the 'Theory of Everything' convincingly before giving a right answer to above 'simple' questions.

2.5 Space-time panorama

Not only do we give a math show of Schrödinger equation in this chapter but we also set it up on substantial and more representational principles, therefore we have reasons to scan all physical theories with deflection of space-time:

Domain of space-time variable q		
0 $y = y_0$	Absolute space-time	Newtonian theory
[0, $\pi/2$] $y = y_0 \cos q$	Relativistic space-time	Relativity
[0, $+\infty$) $y = y_0 \cos wt$	Quantum space-time	Quantum mechanics
[$2k\pi+\pi/2$, $2k\pi+3\pi/2$], k = 0,1,2...+ integers	Negative space	Black holes

2.5.1 Absolute space-time

It is the space-time where we live. We have absolute time and absolute space here, which has ruled humans' views for thousands of years. So far it has had deep influence on our thinking and philosophical viewpoints because the world we experience is at a low speed. No one can change low-speed reality any further in this space-time. Facing this 'reality', what physicists could do is to shorten the distance between subject and object at best.

2.5.2 Relativistic space-time

About a century ago, Einstein discovered the relativistic space-time and thought that space-time should not be absolute anymore and that absoluteness of space and time was no longer applicable in this space-time. After years elaborate design, he described the space-time as a curved, multi-dimensional and forth raised space, an end of which is absolute space-time and the other end is a black hole ($q = \pi/2$) where all classical physical theories are invalid. It is a pity that he did not find that the relativistic space-time is only a small part of entire space-time wave band.

2.5.3 Quantum space-time

Quantum space-time deals with a farther range than relativistic space-time does. As it expands wave band from [0, $\pi/2$] to [0, $+\infty$), it should be said that both absolute space-time and relativistic space-time are special cases of quantum space-time. Scientists find that it is difficult to determine both position and momentum of particles at the same time and, furthermore, energy distribution is not continuous. Why is energy distribution discrete and where is the 'lost space'? We have known from this article that there are minus space in [0, $+\infty$) according to STWF and that is the 'lost space' we look for. Generally, space and energy are symmetrical along time axis, the only problem is that we can not feel minus energy and minus space directly. It is understandable for us to introduce negative space.

2.5.4 Negative space

It needs considerable courage to accept minus space that is a forbidden zone in classical theory. We should have a stably theoretical base to complete the span of space-time. With a very simple math model, TAST depicts a panorama of space-time and provides an essential tool for us to understand the entire analytical space-time system. If we expect to do something in space-time field, we have to cast away our intrinsic conception -- God is always in favor of humans. Positive space is wholly the same as negative space in symmetry and just depends on which side humans believe we stand by!

So far we have unified the principles of Relativity (special and general) and quantum mechanics on the foundation of TAST, thus the principles of existing theories of physics become the results of TAST.

From the development of pure science, we see that we take some things as phenomena while taking other things as essence to describe our experiences. When we reach a deeper level in science, the essence or principles at the upper level become the manifestation and we use more comprehensive principles as essence. We believe that all explanations of the world will converge upon simpler and simpler principles and that the laws that govern the behaviors of cosmos are already connotative in the theories such as Relativity, Quantum mechanics, Natural selection, etc. We will find that TAST is related to matter & energy, origin and evolution of cosmos, order of masterdom over lives, mechanism of mind or consciousness as well as to the old, primal and essential questions in philosophy, i.e. subjective & objective, mind & matter and consciousness & existence.

We understand the world by learning and discovering the regularity in our experiences. There are two kinds of regularity, mechanical laws and statistical order. It is TAST that may combine the both theoretically!

Now that TAST, as commented in a special review on TAST, has had us see the aureole of God through the general effect of deflection or rotation of space-time, would it lead us to see the true face of God or comprehend the mind of God?

Turn the key, you open the door.

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(To be continued)