SunQM-7s1: Space Formation/Transformation, Relativity, and the Possible Origin of the Lightspeed and Its Constancy (Viewed From the {N,n} QM)

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Abstract

The newly established {N,n} QM includes the Bohr-QM based part (see in SunQM-1 series, SunQM-2, SunQM-5 series, and SunQM-7), the Schrodinger-equation based part (see in SunQM-3 series and SunQM-4 series), and the {N,n} quantum field part (see in SunQM-6 series). In the SunQM-7 series, I am going to study the relativity under the {N,n} QM. In the current article, first, I used Schrodinger equation/solution (i.e., the wave function) as a tool to study how the space is formed from x-1D to the flat xy-2D, the point-centered rφ-2D, the flat xyz-3D, the point-centered rθφ-3D, and then the point-centered r'rθφ-4D. The orthogonality of the dimensions was discussed. Many examples of the dimension transformation (that were encountered during the {N,n} development, e.g., "opened-space" versus "closed-space", "straight-space" versus "curved-space", larger size 3D space may allow the higher dimension 4D to be effective, etc.) were discussed. Second, based on the Newtonian mechanics (that in the Earth's orbit that around the Sun, all mass entities (e.g., a H-atom, a space dust, etc.) have the same constant orbital speed as that of the Earth), and also based on that our 3D universe may be a spherical 3D space on the surface of a 4D ball something, I explained the origin of the lightspeed as that "it is the orbital speed in a r'rθφ-4D space". It also automatically explained the origin of the constancy of the lightspeed. These origin explanations may in turn support the correctness of the two axioms in the modern physics: "the lightspeed is the maximum (effective) speed in our universe", and "the speed of light is constant in our universe". Third, I further hypothesized that a group of (large number) random direction/phase "4D thermal oscillators" forms a massed particle that localized in our 3D universe, and a group of (small number) unified direction/phase "4D thermal oscillators" forms a massless photon that un-localized in our 3D universe. This model made me able to further explain several other properties in the general relativity and the special relativity (see in SunQM-7s2). Fourth, because I believed that (in 3D space) a black hole not only stops the light but also stops the gravitational force to escape from its surface, I hypothesized that a black hole may indirectly exert its gravitational force in 3D space (by projecting of its 4D space G-force through the 4th dimension back into the 3D space).

Key Words: Quantum mechanics, {N,n} QM, relativity.

Introduction

In August 2016, I discovered that the Solar system can be described by a brand new {N,n//6} quantum mechanical structure [1]. Based on that result, (during the 10 years of the closed-door research), I further (independently) developed the {N,n} QM theory, and showed that not only the formation of Solar system [1] ~ [16], but also the formation of the whole universe [17] ~ [25], may can be described by the {N,n} QM. (Note: As an independent scientist, some of my research work may belong to a citizen-scientist-leveled work). As part of the {N,n} QM development, I (independently) designed and developed a brand new {N,n} QM field theory (for any point-centered field, like a mass field, a force field, an energy field, etc.) [23] ~ [24], [26] ~ [34]. The foundation of this theory includes: the four fundamental forces (Gravity, Electromagnetic, Strong, Weak,

abbreviated as G-, EM-, S-, W-forces) have been re-classified into three pairs of force (E/RFe-force, G/RFg-force; S/RFs-force, see SunQM-6); all point-centered fields (including the mass field, the force field, and the energy field) can be represented by the Schrodinger equation/solution (in form of non-Born probability as well as in form of a 3D spherical wave packet, see SunQM-6s4); the non-Born probability description (that equals to the re-explanation of the Born probability density) as the collection of all elliptical orbital tracks (or, the Born probability density map's contour lines can be re-explained as the trajectory of a motion electron, see SunQM-6s2's Fig-2), the spherical 3D wave packet description (with each shell's diameter equivalent to about one wavelength of the matter wave), the dis-entanglement of the outmost shell of the 3D wave packet (i.e., the "general decaying" process, see SunQM-6s1, -6s2, -6s3), the "|nL0> elliptical/parabolic/hyperbolic orbital transition model" (see SunQM-6s2, -6s3), the seamless transformation between a quantum process and a continues process through moving the r_1 inward (see SunQM-5s2), and the trick that using the high-frequency n' quantum number to pin-point any small region in the {N,n} QM field (see SunQM-3s11, SunQM-6s1, etc.). So, the {N,n} QM is constituted with two parts: the Bohr-QM part (with {N,n} structure added), and the Schrodinger-equation-QM part (with RF, and {N,n} QM field theory added). In the current paper, I presented my over ten years of thinking on the space formation, transformation, orthogonality, and my exploration on the possible origin of the lightspeed and its constancy. (Note: I am not a relativity physicist. I am a {N,n} QM scientist. All I did here is to develop a {N,n} QM field theory to re-describe some relativistic phenomenon. All these re-descriptions may belong to a citizen-scientist-leveled work).

Note: **QM** means Quantum Mechanics, **RF** means "**R**ota**F**usion" (or rotation diffusion), **BH** means "black hole", **GR** means "general relativity", **SR** means "Special relativity", |n/m> means |n,*l*,m> QM state, "**nLL**" or |nLL> means |n,*l*,m> QM state with *l* = n-1 = L, and *m* = n-1 = L. "**nL0**" or |nL0> means |n,*l*,m> QM state with *l* = n-1 = L, and m = 0. For {N,n} QM nomenclature as well as the general notes, please see SunQM-1's sections VII & VIII. Note: The best reading sequence for the (35 posted) SunQM series papers is: SunQM-1, 1s1, 1s2, 1s3, 2, 3, 3s1, 3s2, 3s6, 3s7, 3s8, 3s3, 3s9, 3s4, 3s10, 3s11, 4, 4s1, 4s2, 5, 5s1, 5s2, 7, 6, 6s1, 6s2, 6s3, 6s4, 6s5, 6s6, 6s7, 6s8, 6s10, 6s10, and 7s1. Note: for all SunQM series papers, reader should check "SunQM-9s1: Updates and Q/A for SunQM series papers" for the most recent updates and corrections. Note: Microsoft Excel's number format is often used in this paper, for example: x^2 = x^2, 3.4E+12 = 3.4*10^{12} = 3.4×10^{12}, 5.6E-9 = 5.6*10^{-9}. Note: In previous SunQM papers, the current paper was cited as "SunQM-7s1: Relativity and non-linear {N,n} QM … (part-1)".

I. Space formation, transformation, orthogonality, "Closed-space" versus "Opened-space", "straight-space" versus "curved-space", and the high-dimension space versus low-dimension space

I-a. Space formation (from 0D space to 1D space, 2D space, and then to 3D space)

(Note: the major part of section-I was from my thought during 2015 ~ 2017). In SunQM-1, I said: "*From Sep. 2015 to Aug. 2016, after countless matching and thinking … and after many times reading of many QM text books, I gradually gained more understanding of the physical meaning of Schrodinger equation, its solution*, … *space formation/transformation/orthogonality*, … (*which I will explain them in next several papers*)". The current section is to continue this topic.

In the {N,n} QM field theory, under a point-centered G/RFg-force field (in a rθφ-3D space), or a point-centered E/RFe-force, or a "quasi point-centered" S/RFs-force, the {N,n//6} QM structure covers our whole universe from N = +10 down to N = -17 (see SunQM-7's Table-1). Furthermore, the {N,n} QM field can be fully described by the Schrodinger equation/solution (in form of either the Born probability **BP**, or the non-Born probability **NBP**, or a 3D wave packet). In SunQM-6s8's Appendix G, I pointed out: "*Why Schrodinger equation/solution can be applied to both macro-world and micro-world? This is because the Schrodinger equation/solution only describes the point-centered (or a point-symmetric) radial radiating field (and also including the RF). So it can be used to describe any the point-centered (or a point-symmetric) radial radiating (mass, or force, or energy) field, like a Sun's point-centered mass field (or mass distribution), or a Sun's point-centered G/RFg-force field, or a Sun's point-centered gravitational potential field, or an atom's point-centered mass*

distribution, or an atom's point-centered E/RFe-force field, etc. However, for a chemical molecule, or a crystal structure, because their structures seriously deviated from a point-centered (or a point-symmetric) radial radiating field, they cannot be described by a simple Schrodinger equation/solution".

In this section, I will use that how the Schrodinger equation's solution (i.e., the NBP) changes in 1D, 2D, and 3D space, to illustrate how the space is changed from 1D to 2D, or from 1D to 3D. Here we only interested in the {N,n//q} QM related rθφ-3D space, that means, a rθφ-3D space in which a point-centered G/RFg, E/RFe, S/RFs-force fields is applicable, or, the Schrodinger equation/solution is applicable. To do this, let's start with the radial wave function of an H-atom's Schrodinger equation/solution (because this is the only one I have learned so far). Figure 1a illustrated a space formation from 0D (i.e., a size-less point) space to 1D (i.e., a line) space. Figure 1b illustrated a x-1D Schrodinger equation/solution (as the wave function for n = 1, 2, 3 states) in a x-1D infinity deep potential well [35], [36]. Figure 1c illustrated a xy-2D Schrodinger equation's solution (as the wave function for n = 1, 2, 3 states) that is expanded from a x-1D infinity deep potential well (or, a x-1D space) to a xy-2D infinity deep potential well (or, a xy-2D flat space, see wiki "Particle in a box"). The sine wave function in the newly added y-1D is exactly the same as the sine wave function in the x-1D. We can further increase the dimension in Figure 1c from xy-2D to xyz-3D by expanding to the 3rd dimension (figure not shown here), and notice that in the xyz-3D, there is no RF between two dimensions. (Note: in comparison, if we expend only one end of 1D (in Figure 1b) to rθφ-3D (see in Figure 1e), then the newly added θ-1D and φ-1D will have to RF with each other).

Figure 1d attempted to illustrate the Schrodinger equation/solution (as the wave function for n = 1, 2, 3 states) is expanded from a x-1D space (i.e., r-1D space) to a (round) rφ-2D space (through a distorted xy-2D). First, in the newly added y-1D, let's increase by 1δ distance at the r = 0 end, and increase by 2δ distance at the r = r end, we see that the peak of the wave function shifted towards to the r = 0 end, (because the wave function intensity (i.e., the NBP) is divided by 1δ at the r = 0 end, and divided by 2δ at the r = r end). Then, after decreasing the newly added distorted y-1D increment to 0δ at the r = 0 end, and to 1δ at the r = r end, the peak of the wave function shifted to exactly the r = 0 position (see Figure 1e, because when x → 0, the wave function intensity sin(x) → x), and it becomes a (round) rφ-2D space, and not a (distorted near-flat) xy-2D space anymore. In this case, the NBP of sin(x) in x-1D is now become NBP of [sin(x)/x] kind of function in the r-1D sub-space (of the rφ-2D space) as shown in Figure 1g (that plotted with the WolframAlpha). In the φ-1D (of the rφ-2D space), the wave function is still a standard sine-type function (figure not shown here).

Then, Figure 1h showed that how the NBP (as the Schrodinger equation's wave function for n = 1, 2, 3 states) is expanded from a x-1D space (i.e., r-1D space) to a point-centered rθφ-3D space. In this case, the NBP of sin(x) in x-1D is now becoming NBP of $[\sin(x)/x^2]$ kind of function in rθφ-2D, because the NBP at each point of x-1D is now divided by the θφ-2D spherical surface area $4\pi r^2$. The (WolframAlpha plotted) Figure 1f, Figure 1g, and Figure 1h correlate to the wave functions in x-1D space, rφ-2D space, and rθφ-3D space. Check with the QM text book [37], we found that these curves match to Schrodinger equation's radial wave functions of $a_0^{3/2} R_{1,0}$, $a_0^{3/2} R_{2,0}$, and $a_0^{3/2} R_{3,0}$, also see in Figures 1 (i, j, k).

According to [37], when a x-1D space expanded into a rθφ-3D space, each n state is further divided into a set of |n,*l*> sub-states with *l* = 0 ... (n-1), see the illustration in Figures 1 (i, j, k). (Also see more discussion in Appendix A "Maybe we should re-name |n=3,*l*=0..2> as |n=3,n"=3..1>"). Furthermore, when a x-1D space expanded into a rθφ-3D space, the r-1D NBP peak position-shift will follow the Bohr formula of $r_n = r_1 n^2$, and automatically causes $r_{n=1} < r_{n=2} < r_{n=3}$. (Question for myself: Is this only for the attractive force field? And, if a x-1D space expanded into a rφ-2D space, does the r-1D NBP peak position-shift still follow the Bohr formula of $r_n = r_1 n^2$?).

Then, (see wiki "Table of spherical harmonics"), according to |3,2,0>, |3,2,1>, and |3,2,2> QM states' θφ-2D wave function,

$$Y_2^0(\theta, \varphi) = \frac{1}{4}\sqrt{\frac{5}{\pi}} \cdot (3\cos^2\theta - 1) \ ,$$

$$Y_2^1(\theta, \varphi) = \frac{-1}{2}\sqrt{\frac{15}{2\pi}} \cdot e^{-i\varphi} \cdot \sin\theta \cdot \cos\theta \ ,$$

$$Y_2^2(\theta, \varphi) = \frac{1}{4}\sqrt{\frac{15}{2\pi}} \cdot e^{2i\varphi} \cdot \sin^2\theta,$$

we can see that once a x-1D space expanded into a rθφ-3D space, its wave function in φ-1D is still sine-like ($e^{-i\varphi}$, or $e^{2i\varphi}$), its wave function in θ-1D is de-shaped sine-like (either $3\cos^2\theta - 1$, or $\sin\theta \cdot \cos\theta$, or $\sin^2\theta$). Furthermore, as I had

pointed out before, once a x-1D space expanded into a rθφ-3D space, its φ-1D is automatically RF (RotaFusion, or rotation diffusion) with the θ-1D (see SunQM-6s9's section-VII), so that a spherical harmonic function (with imaginary numbers) is needed to describe the θφ-2D space. Because of this RF, it is impossible (in any QM text book?) to show a picture of a rθφ-3D wave function in all rθφ three dimensions. In Figure 1*l*, I drew a picture with the attempt to illustrate what may look like for some of the characters of a rθφ-3D wave function (note: this figure is only a citizen scientist's illustration, strictly to say, it is incorrect, because it is unable to show the RF in θφ-2D).
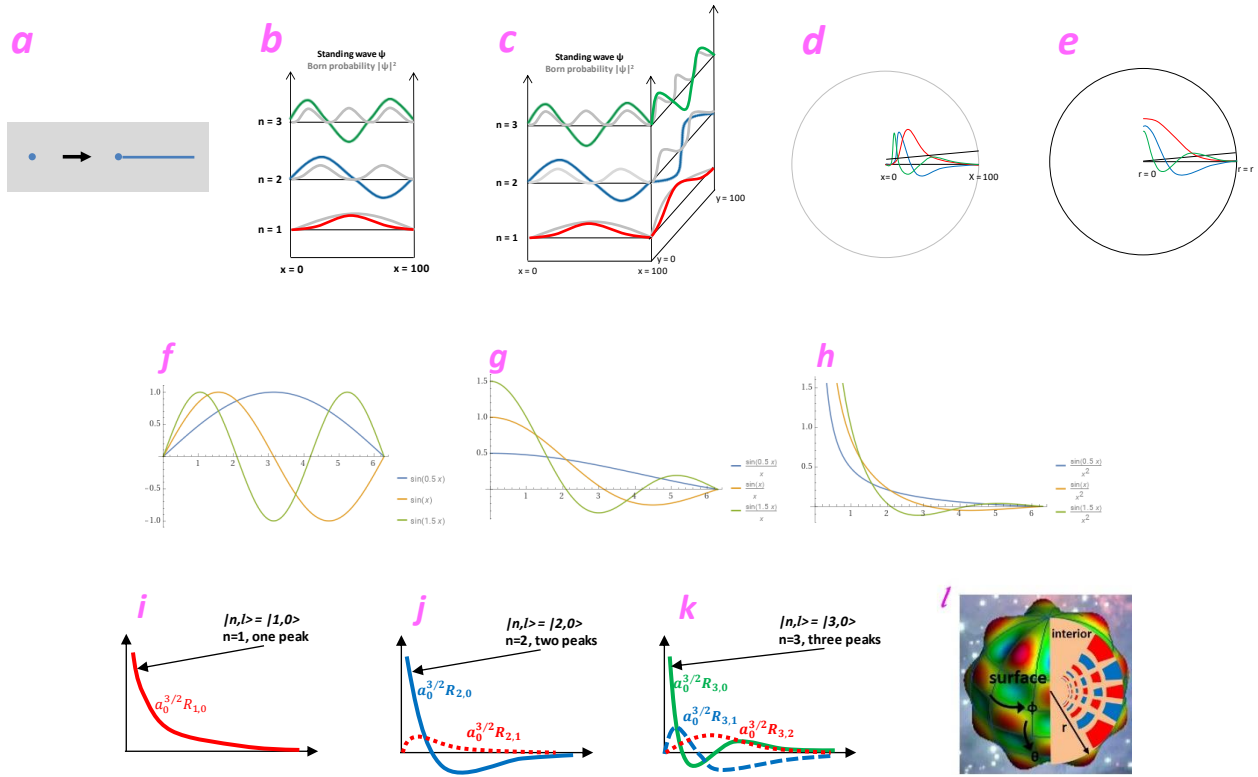

Figure 1a. To illustrate a space formation from 0D (i.e., a size-less point) space to 1D (i.e., a line) space.
Figure 1b. To illustrate a x-1D space with the Schrodinger equation/solution for n = 1, 2, 3.
Figure 1c. To illustrate a xy-2D (flat) space with the Schrodinger equation/solution for n = 1, 2, 3.
Figure 1d. To illustrate a xy-2D (distorted towards to rφ-2D) space with the Schrodinger equation/solution for n = 1, 2, 3.
Figure 1e. To illustrate a rφ-2D space with the Schrodinger equation/solution for n = 1, 2, 3.
Figure 1f. To illustrate a x-1D space with the NBP for n = 1, 2, 3 by using sin(x) function, plotted by WolframAlpha.
Figure 1g. To illustrate a rφ-2D space with the NBP for n = 1, 2, 3 by using sin(x)/x function, plotted by WolframAlpha.
Figure 1h. To illustrate a rθφ-3D space with the NBP for n = 1, 2, 3 by using $sin(x)/x^2$ function, plotted by WolframAlpha.
Figure 1i. To illustrate a rθφ-3D space with the NBP (i.e., the radial wave function) for n = 1, as shown in [37].
Figure 1j. To illustrate a rθφ-3D space with the NBP (i.e., the radial wave function) for n = 2, as shown in [37].
Figure 1k. To illustrate a rθφ-3D space with the NBP (i.e., the radial wave function) for n = 3, as shown in [37].
Figure 1*l*. To illustrate some characters of a wave function $\psi(r, \theta, \varphi) \propto a_0^{3/2} R(n, l = 9) Y(l = 9, m = 5)$ in each of φ-1D, θ-1D, and r-1D space. The (background of the) spherical harmonic Re[Y(9,5)] surface was plotted by using the (free) online plotter at "http://icgem.gfz-potsdam.de/vis3d/tutorial". Copied from my paper SunMQ-6s9's Fig-2d.

Next, I try to verify the above x-1D to rθφ-3D space expansion by reversing this process, i.e., to collapse a point-charge's electric force from a rθφ-3D space back into a x-1D space. In SunQM-6s10's section-III, I mentioned that "*for a H-atom's proton-electron pair, the proton's E-force field may can be explained as that: it has only one E-force line that radiating to a single direction to the electron, and then the (synchronized) RF motion of both proton and electron makes this E-force line to spread all over 4π directions (as a time averaged effect)*". In a H-atom, a proton attracts an electron with the point-centered force $F_{r\theta\varphi} = \frac{-e^2}{4\pi\varepsilon_0}\frac{1}{r^2}$, see [38] ~ [40]. Once you integrated all force lines in the rθφ-3D space, it becomes

$$\iiint F_{r\theta\varphi} = \int_0^a \int_0^\pi \int_0^{2\pi} \frac{-e^2}{4\pi\varepsilon_0}\frac{1}{r^2}r^2 \sin\theta \; dr \, d\theta \, d\varphi = \frac{-e^2 a}{\varepsilon_0}$$. On the other hand, if in a x-1D space there are two charges (one +e,

one -e, with distance = a, and with a constant force $F_x = \frac{-e^2}{\varepsilon_0}$), then you integrated this single force line in the x-1D space, it

becomes $\int F_x = \int_0^a \frac{-e^2}{\varepsilon_0}dx = \frac{-e^2 a}{\varepsilon_0}$. Both results are the same. So, I believed that by collapsing a point-centered 3D force into a x-1D force, you can collapse a point-centered rθφ-3D space into a x-1D space. Or, a rθφ-3D force with $F_r \propto \frac{1}{r^2}$ is equivalent to a x-1D force with the constant strength $F_x \propto x^0$.

Furthermore, a x-1D force with the constant strength can be constituted by the "Fourier summing" of all QM states in Figure 1b (from n=1 to n=∞, i.e., a constant line can be Fourier transformed into many sine functions with all different frequencies), and a point-centered 3D force $F_r \propto \frac{1}{r^2}$ can be constituted by summing an H-atom's all wave functions (in {N,n//6} QM form, from N→ -∞ to N→ +∞ to, see SunQM-6s4's eq-7; that also equivalents to from n=1 to n=∞, see SunQM-6s4's section-II). This analysis revealed that, a (reversible) transformation of rθφ-3D space into a x-1D space can be achieved by a (reversible) transformation of rθφ-3D wave function into a x-1D wave function. I believed that this result confirmed all discussions in the current section.

In this way, (from a citizen scientist's view), based on the Schrodinger equation/solution, I explained the space formation from 0D space to 1D space, then to 2D space, then to a point-centered rθφ-3D space. Furthermore, this space formation from a 1D space to a point-centered rθφ-3D space not only is the origin of the Bohr's quantum orbital-r formula $r_n = r_1 n^2$ (in which when n = 1, 2, 3, 4, ... , r = 1×, 4×, 9×, 16×, ... of r_1), but also is the origin of the Newton's (free-fall) accelerated distance formula $d = \frac{1}{2}g\,t^2$ (in which when t = 1, 2, 3, 4, ... , d = 1×, 4×, 9×, 16×, ... of $\frac{1}{2}g$, see more discussion in SunQM-7's section VII).

I-b. Dynamic space transformation (part-1)

Below I listed some dynamic transformation between the different space dimensions that I encountered during the {N,n} QM field theory development.

1) In SunQM-6, I re-named the electromagnetic force as the **E/RFe-force**, with the electric force (**E-force**) as the primary force that initially only exerts in r-1D space (in nL0 mode, when a charge is in static), and with the **RFe-force** as the orthogonal companion force of the E-force that initially only exerts in θφ-2D space (in the complete RF of nLL mode, when the charge is in static). Then, the magnetic force (i.e., the magnetic $\vec{\mathbf{B}}$ field line) is either the (partially de-RF) nLL mode of RFe-force (when a charge is in translation), or the "==inversed RFe-force==" (in ==quasi-nL0-mode==, when the charge is in spinning, so that it produced a new force component in r-1D (together with the θφ-2D), here we named it as the "==quasi-r-1D=="). When a charge changed from a translational motion into a rotational (or spinning) motion, we see that the same magnetic $\vec{\mathbf{B}}$ field line will change from the nLL mode (in φ-1D space) into the quasi-nL0 mode (mainly in r-1D space, minorly in θ-1D space). This means that in a |n,*l*,m> QM state, the nLL (with the quantum number m = max) QM state force field and nL0 (with m = 0) QM state force field are (topologically?) inter-changeable, or, the φ-1D and r-1D are dynamically transformable.

2) See SunQM-6s9's Appendix C: "The apparent $V_{\theta\varphi} < 0$ (or $V_{\theta\varphi} > 0$) may transform its exertion space from θφ-2D space to r-1D space, and cause the V_r change". For examples, in a single n-shell of an atom, all electrons (that exerting repulsive force to each other in θφ-2D) will dynamically transform its exertion dimension from θφ-2D to positive r-1D. This also means, in a single n-shell of a pre-Sun ball, all objects (that exerting attractive force to each other in θφ-2D) will dynamically transform their exert dimension from θφ-2D to the negative r-1D. This method had been used in SunQM-6s6's section-II, "Using Schrodinger equation for H-atom (with $V_{\theta\varphi} > 0$) to explain the Z > 1 atom's ground state electron configuration (without using the "penetrating" theory)".

3) At a translation speed close to the lightspeed (v → c), the dynamic space in the front (of a high-speed particle) is compressed to nearly zero, see SunQM-6s5's Fig-8c.

4) SunQM-6s7's section VII-c: "*For a pair of spin ↑↓ electrons, their (electron-proton) face-to-face tidal-locked orbital rotation in φ-1D (in the opposite ±m directions) may have transformed into a θ-1D uni-directional orbital rotation*".

5) SunQM-6s8's section I-a: the example of the transformation from φ-1D to r-1D, "*a photon is always increasing its (r-1D) size (as it is propagating in x-direction), because it is actually increasing its φ-1D size*".

6) See SunQM-7s2's section-II: "*when apparently all mass on a BH surface is flying inward at the lightspeed c (see in SunQM-7s2's Fig-3b'), actually it is that all mass on the BH surface is also doing the circular 1D orbital motion in the lightspeed c (see in SunQM-7s2's Fig-3d)*".

7) The complicated formulas in SunQM-6s9's eq-17, eq-27, and eq-31, that I am still trying to understand better.

I-c. Space orthogonality, (and the possible origin of the violation of the parity conservation in weak interactions)

In SunQM-6s9's section-VI, I said "*The Cartesian xyz-coordinate described 3D space is only a sub-space of a spherical rθφ-coordinate described 3D space, thus xyz-3D space may not give a complete description for a point-central field's 3D space … in a xyz-3D coordinate space, for anyone of x, y, z-axis, the other two axes may be not (fully) orthogonal with each other … I believe that in a point-central field, for z-axis, the only full-orthogonal dimension is the circles (or the circling space) of either exp(+iφ) or exp(-iφ) in xy-plane (i.e., Euler's formula in 2D), or the two circular axes of x+iy and x-iy …*". In other words, in xyz-3D, for the z=0, there is no (full) meaning that if x-axis is orthogonal to y-axis or not (because you need to introduce an imaginary number between x and y). In xy-2D, there is (full) meaning that whether x-axis is orthogonal to y-axis or not (because you don't need to introduce an imaginary number between x and y). (Note: This is equivalent to say, when x-1D space expended to a rθφ-3D space, the θ-1D and the φ-1Dis automatically in RF, see SunQM-6s9's section VII). Again in other words, in xyz-3D, relative to the z-axis, the orthogonal of x-axis to y-axis is not a complete description of the orthogonality of xyz-3D (because of the RF). Alternatively we can say: in a point-centered rθφ-3D space, nLL mode to nL0 mode is the full orthogonal, x±iy axis to z axis is the full orthogonal, and xyz axis are not the full orthogonal. Furthermore, all point-centered fields (including force field, mass field, energy field, like that of G/RFg-force field, E/RFe-force field, S/RFs-force field, etc.) showed the same full orthogonality as the space orthogonality. This means, the full orthogonality of space and fields have the same origin, and they are actually the same thing but showed up in many different ways. (Also see SunQM-7s2's Fig-4 that rθφ-3D may equivalent to the point A, and xyz-3D may equivalent to the point B).

In this way, the origin of the violation of the parity conservation in weak interactions may come from the RF property of the space, (see wiki "parity").

I-d.   Dynamic space transformation (part-2): "Opened-space" vs. "Closed-space"

Let's imagine a physical process in which a free electron flies toward to a free (static) proton and then is captured by this proton to form an H-atom. According to the standard QM theory, when this electron is far away from the proton, it equivalents that an electron (in an H-atom) has the quantum number $n \to \infty$; when this electron is approaching to the proton, it equivalents that an electron (in an H-atom) has the n value decreasing; when this electron is fully bound to the proton (with the lowest binding energy), it means that an electron (in an H-atom) is in the n =1 QM ground state. Notice that after the electron goes to the n=1 state, it no longer flies in the r-1D space to further approach to the proton, and it is fully "locked" in the $r_{n=1}$ orbital space, or in the {-12,1//6} o orbital shell space. Let's <mark>name the n = 1 electron (that has 100% RF in an H-atom)</mark> is in a "**closed-space**", meaning the θφ-2D is "closed" to the r-1D space, or, its motion is locked as a "fixed r" in the rθφ-3D space (although its motion is still free in the θφ-2D of the rθφ-3D space, note: this is under Bohr atom's circular orbital model, and ignore the elliptical orbital model). In contrast, let's name <mark>the high n state electron (that has RF much less than 100% in an Bohr H-atom)</mark> is in a "**opened-space**", meaning the θφ-2D is "opened" to the r-1D space, or, its motion is free in the r-1D space of the rθφ-3D space (besides its motion is free in the θφ-2D of the rθφ-3D space). In this way, a process of a free electron flying to a proton to form an H-atom becomes a process that a free electron flies from an "opened-space" (i.e., an opened rθφ-3D space) into a "closed-space" (i.e., an opened θφ-2D space but with the closed r-1D space). Oppositely, (under an external force field), when an electron in an H-atom is excited from n = 1 to n = ∞ to become a free electron, it can be said as this electron goes from a "closed-space" to an "opened-space". (Note: In SunQM-2's Table-6, I showed the % of RF for the electron (in H-atom) at different n orbits. It was calculated based on the Bohr-QM vs. Schrodinger-QM. It may can be used as the reference for what is the % of RF for each n state).

The above description is under the E/RFe-force field. It also can be used for the G/RFg-force field. For example, a BH surface may can be said as a "closed-space". The matter (from a companion start) that flying into the BH surface can be said as that it flies from the "opened space" to the "closed-space".

Why in the "closed-space", the r value is "fixed" or "locked" in r-1D? This is because that the r-1D attractive force bended r-1D space (Einstein's General relativity?). When the r-1D attractive force strength is too strong, it will bend r-1D space 100% backward, and causes the r value to be "fixed" or "locked". This physical phenomena can be illustrated by the n=1 electron motion in an H-atom: (although in rθφ-3D, an n=1 electron motion is doing the elliptical orbital motion around the proton), in r-1D, we can simplify that the n=1 electron is doing an oscillation motion between $r_{n=1} = 1\times$ 5.29E-11 meters and $r_{n=2} = 4\times$ 5.29E-11 meters. The super strong E/RFe attractive force bended the r-1D space 100% backward at the $r_{n=2} = 4\times$ 5.29E-11 meters so that the electron has to move backward (towards the force field center). (Alternatively, we may can say that the E/RFe quantum force bended the r-1D space 100% forward (or outward) at the $r_{n=1} = 1\times$ 5.29E-11 meters, and bended the r-1D space 100% backward (or inward) at the $r_{n=2} = 4\times$ 5.29E-11 meters, so that the electron has to move in between). (Note: This cannot be explained by Einstein's General relativity). In comparison, for the n = 2 electron in an H-atom, besides that it is also bended the r-1D space 100% forward (or outward) at the $r_{n=1} = 4\times$ 5.29E-11 meters, and bended the r-1D space 100% backward (or inward) at the $r_{n=2} = 9\times$ 5.29E-11 meters, it has a high probability of spontaneous de-excitation to n = 1 orbit, and this is the character of a partially "opened space" (that the n = 1 electron lack of).

Similarly, we may can say that for a Sun-massed BH, the super strong G/RFg attractive force bended the r-1D space 100% backward at the out-edge of the {-4,5//6}o orbital shell, so that the matter has to move backward (towards the force field center). (Note: This can be explained by Einstein's General relativity).

In a broader sense, there may be many different levels of "closed-space". For example, we may can say that
1) three quarks are moving inside a "closed-space" (i.e., inside a nucleon, under S/RFs-force);
2) a (proton-merged) electron is moving inside a "closed-space" (i.e., inside a neutron, under E/RFe-force);
3) an n=1 electron of a H-atom is moving inside a "closed-space" (i.e., inside an H-atom, under E/RFe-force);
4) an π electron of a benzene molecule is moving inside a "closed-space" (i.e., inside a benzene molecular ring, under the residue E/RFe-force, and de-localized from any single atom);
5) a BH has a "closed-space" for its matter (under the G/RFg-force);
6) our universe is a "closed-space" for its matter (under the residue G/RFg-force?).

I-e. Dynamic space transformation (part-3): "straight-space" vs. "curved-space"

Similar as that a space can be transformed dynamically from an "Opened-space" to a "closed-space", or vice versa, we also see a space can also be transformed dynamically from a "straight-space" to a "curved-space", or vice versa. In SunQM-2, I mentioned that "… *just like the short λ wave goes straight line and long λ wave goes curved line, a proton's matter wave goes straight inside Sun core, and a Sun core's matter wave goes curved line in proton (by RF^15). Or, a Sun core's matter wave goes straight inside universe, and a universe's matter wave goes curved line in Sun core by RF^X*". This means, whether a space is a "straight" or a "curved", it is relative to the wavelength of a matter wave. In other words, the same space can be either a "straight-space" for a short wavelength of a matter wave, or a "curved-space" for a long wavelength of a matter wave. For example, our Sun (as a "matter wave resonance chamber", or MWRC) is not only a "straight-space" for a proton's matter wave, but also a "curved-space" for the Milky Way galaxy's matter wave. In other words, in a large space, a matter wave (or a field) propagates in straight line; and in a small space, a matter wave (or a field) propagates in curved line. For example, "a free electron captured by a proton to form an H-atom" can be said as the electron goes from a "straight-space" to a "curved-space", and when the "curved-space" become extremely curved, it turns out to a "closed space". When a proton-electron pair in an H-atom (that has a size of {-12,2//6}) is compressed into a single entity (i.e., a neutron, and it has a size of {-15,1//6}), it can be said as the electron goes to an even closed space with RF^3 (see SunQM-2's section IV-c for the meaning of RF^3).

In a QM system, I guessed that the higher the n, the larger the r_n space, and the higher % of the r-dimension component (among the rθφ-3D components) in the kinetic energy for an object in this r_n space. Similarly, the lower the n, the smaller the r_n space, and the higher % of the θφ-dimension component (among the rθφ-3D components) in the kinetic energy for an object in this r_n space. This may explain that in GR, the closer the distance to a BH, the more radial contraction it will get. This may also explain the "color confinement" in the section I-g. Also see SunQM-7s2's section-X.

I-f. From a point-centered rθφ-3D space to a point-centered r'rθφ-4D space

(Note: Whenever I mentioned the "4D space" in the current paper, it does not include the time dimension, so this 4D space has nothing to do with Einstein's 4D-spacetime, unless it is specified). Here is one alternative description for the 2D, 3D, and 4D spaces:

1) In a standard point-centered rθφ-3D space (that the G/RFg-force and the E/RFe-force applied), the r-1D is a half-space (meaning $0 \le r \le \infty$), the θ-1D is also a half-space (meaning $0 \le θ \le π$, that equivalent to $0 \le r \le \infty$), and the φ-1D space is a full-space (meaning $-π \le φ \le +π$, that equivalent to $-\infty \le r \le +\infty$). (Note: In a special rθφ-3D space that has $0 \le r \le \infty$, $-π \le θ \le +π$, and $-π \le φ \le +π$, it will show the Mobius effect, see SunQM-6s7' Fig-4c. It is not included in our current discussion).

2) In a (most commonly used) θφ-2D space (that the color-force used, or the S/RFs-force mainly used), the θ-1D is a half-space (meaning $0 \le θ \le π$, that equivalent to $0 \le r \le \infty$), and the φ-1D space is a full-space (meaning $-π \le φ \le +π$, that equivalent to $-\infty \le r \le +\infty$). Alternatively, we also can say that the color-force (or the S/RFs-force) used a rφ-2D space, with the r-1D as a half-space ($0 \le r \le \infty$), and the φ-1D space as a full-space (equivalent to $-\infty \le r \le +\infty$, see the explanation of "r-1D" vs. "θφ-1D" in Figure 2a for better understanding) for the "color confinement".

3) In a (most commonly used) r'rθφ-4D space (in which the G/RFg-force used), the r'-1D (in the 4th dimension) is a half-space (meaning $0 \le r' \le \infty$), the r-1D (in the rθφ-3D space) is a half-space ($0 \le r \le \infty$), the θ-1D is a half-space ($0 \le θ \le π$, that equivalent to $0 \le r \le \infty$), and the φ-1D space is a full-space (meaning $-π \le φ \le +π$, that equivalent to $-\infty \le r \le +\infty$).

In Figure 2a, I used a spherical 3D space to illustrate a spherical 4D space. To do it, I have to degenerate the θφ-2D (in the normal rθφ-3D space) to be a θφ-1D in the figure (see the circular arrow marked with "θφ" on the surface of the 3D sphere). Then, the radius of the 3D sphere now represents the radius of a 4D sphere at the 4th dimension (i.e., r' in Figure 2a), and the radius of the 2D circular surface area (on the surface of the 3D sphere) now represents the radius of a spherical 3D

surface space (that is the true r-1D in our normal rθφ-3D space, see the r in Figure 2a). Learned and adapted from Einstein's bended spacetime, in a r'rθφ-4D space (not a spacetime), supposing our universe is a 3D spherical space on the surface of a "4D ball something" (also see SunQM-7's section IV-a for the description of a "4D ball something"), a Sun-massed star (with the size of {0,2//6}) will make a small and shallow dent on the surface of this 4D ball (as illustrated as the blue patch in Figure 2a). We can imagine that this dent as a (soap bulb kind of) membrane (at the size of the blue patch) with the Sun mass distributed on the whole membrane. When this Sun-massed star collapsed to be a {-3,1//6} sized BH, this dent become much deeper, and we call it a sink-in (see Figure 2b). When this Sun-massed BH further collapsed to even smaller {-5,1//5} size, this sink-in become even deeper (see Figure 2c). Because the radial space contracted to zero at the surface of the {-3,1//6} sized BH, and the r-1D space inside a BH become meaningless, then all mass of a BH may can be treated as it is distributed only on the spherical surface of this BH. In other words, we may can say that inside a Sun-massed BH, the rθφ-3D space is degenerated into a ==θφ-2D "mass" space== with the r fixed at {-3,1//6}. When using Figure 2c (or Figure 2b) to illustrate this situation, we can imagine that as this dent getting deeper, the (soap bulb kind of) "mass" membrane bursts at the 3D size of {-3,1//6}, the mass on the membrane is re-distributed to the edge, and becomes a "mass" ring (rather than a "mass" membrane) in Figure 2c. (Note: Also see SunQM-7s2's section-II for the possible ==1D "velocity" space== on a BH surface).

Notice that Figure 2a may also can be used to illustrate Einstein's 4D-spacetime. In it, the 4th dimension becomes the t-1D (time dimension), and it is a half-space (meaning $0 \leq t \leq \infty$), and the rest r-1D (a half-space, with $0 \leq r \leq \infty$), the θ-1D (a half-space, with $0 \leq \theta \leq \pi$), and the φ-1D space (a full-space, with $-\pi \leq \varphi \leq +\pi$), are the normal 3D as before.
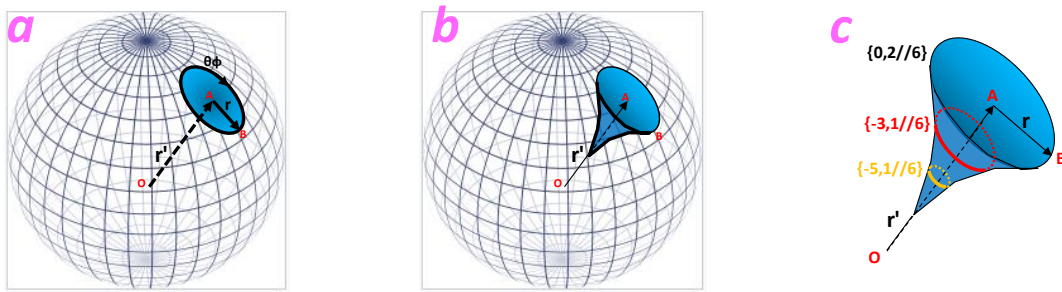

Figure 2a. Illustration of a point-centered r'rθφ-4D space by using a 3D ball.
Figure 2b. Illustration that a black hole's heavy mass density caused a small piece of (originally nearly flat) surface (of the spherical rθφ-3D space that on the surface of a r'rθφ-4D ball) to sink-in (into the r' dimension of the r'rθφ-4D space, with the sink-in direction pointed to the center of the r'rθφ-4D space ball).
Figure 2c. Illustration that in a point-centered r'rθφ-4D space, a Sun-massed star (with size of {0,2//6}) collapsed to a {-3,1//6} sized BH, then collapsed further to a {-5,1//6} sized BH.

I-g. Dynamic space transformation (part-4): Larger size 3D space may allow the higher dimension (i.e., the effective 4D space) to exist, while the smaller size 3D space may only allow the lower dimension (i.e., the effective 2D space) to exist.

Long before 2015, influenced by others (physicists? or citizen scientists? or sci-fi books/movies?) mentioned that the gravitational force may also exist in the 4D space (citation?), I started to believe that the gravitational force not only exists in our current rθφ-3D space, but may also exist in the 4D space, the electromagnetic force may only exist in our current rθφ-3D space (but not in 4D), and the Strong-force may mainly exist in θφ-2D space. The key point of this guess is: ==the larger size space may allow higher dimension to be effective (or become meaningful), while the smaller size space may only==

allow lower dimension to be effective (or become meaningful). For example, for S/RFs-force, its effective range is smaller than {-17,1//6} size, or < 1E-16 meters, so its effective space dimension is more toward spherical θφ-2D rather than spherical rθφ-3D; For G/RFg-force, its effective range is larger than {10,1//6} in size, so its effective space dimension is more toward spherical r'rθφ-4D rather than spherical rθφ-3D.

Here is one way to describe that how the S/RFs-force exist only (or mainly) in θφ-2D space. For three quarks inside a nucleon, I proposed that they are doing the "face-to-face plus face-opposite-face two-level orbital motion" motion (see SunQM-6s10's section-V). Inside a neutron, I guessed that the three quarks (udd) are divided into two sub-structures: a u-d binary sub-structure (that is doing the "face-to-face tidal-locked binary orbital motion" around the reduced mass center of the two quarks "u-d", with the size of {-16,1//6}), and a "d" singlet sub-structure (with the size of {-17,3//6}). These two sub-structures are further formed a binary that is doing the "face-opposite-face locked binary orbital motion" around their reduced mass center, initially in φ-1D bi-direction, and then transformed to be θ-1D uni-direction, to form a {-15,1//6} sized neutron. As wiki "Strong interaction" pointed out: "*The strong interaction is observable at two ranges and mediated by two force carriers. On a larger scale (of about 1 to 3 fm), it is the force (carried by mesons) that binds protons and neutrons (nucleons) together to form the nucleus of an atom. On the smaller scale (less than about 0.8 fm, the radius of a nucleon), it is the force (carried by gluons) that holds quarks together to form protons, neutrons, and other hadron particles. In the latter context, it is often known as the color force. ... color confinement, and it prevents the free "emission" of the strong force: instead, in practice, jets of massive particles are produced*". To accommodate this (text book) knowledge, I guessed that the color-force is a θφ-2D force: first, at the lower level, the "u-d" binary has its S/RFs-force fully locked in the {-16,1//6} sized space (as part of the color-force in the θφ-2D space of the {-17,5//6}o orbital shell space); second, at the higher level, the "u-d"-"d" binary has its S/RFs-force mainly locked in the {-15,1//6} sized space (as another part of the color-force in θφ-2D space of the {-16,5//6}o orbital shell space). Then, the singlet "d" may have small part of S/RFs-force leaked out of the neutron (or beyond the size of {-15,1//6}) to become the nuclear force (in rθφ-3D). Similarly, for a proton, (at the lower level) the "u-d" binary has its S/RFs-force fully locked in the {-16,1//6} sized space (as part of the color-force in θφ-2D space of the {-17,5//6}o orbital shell space), and (at the higher level) the "u-d"-"u" binary has its S/RFs-force mainly locked in the {-15,1//6} sized space (as another part of the color-force in θφ-2D space of the {-16,5//6}o orbital shell space), and the singlet "u" may have small part of S/RFs-force leaked out of the proton (or beyond the size of {-15,1//6}) to become the nuclear force (in rθφ-3D). The biggest advantage of this 3D to 2D space degeneration for the color-force is that it can naturally explain the "color confinement": because it (practically) is a spherical 2D space's force, and this spherical 2D space is sealed (off from a 3D space), so it is impossible to separate out a single free S-force in rθφ-3D space.

Here is one way to describe that how the G/RFg-force exerts not only in rθφ-3D space, but may also in r'rθφ-4D space. According to the text books, a Sun-massed BH will stop the out-propagating photon at the edge of {-3,1//6}. A few scientists (citation?) believed that it will also stop the out-propagating gravitational field at the surface of a BH, and from my "first principle thinking", I think this is very logical. If this is correct, then we will face the problem that a Sun-massed BH will not exert any G-force in a r-1D (in a curved rθφ-3D space) beyond the size of {-3,1//6}, (notice that in Figure 3a, r = 1 is equivalent to size of {-3,1//6} for a Sun-massed BH). In the General Relativity, (I guessed that) Einstein got around of this problem by dumping off the concept of "force", and by using the "geodesics" and the "world line" in a "4D curved spacetime", (see wiki "General Relativity"). As a believer of Newtonian mechanics and quantum mechanics, it is too hard for me to give up the concept of "force" in the "relativistic mechanics", (or, it is too strange when 一个"力学"中没有"力"的概念. Note: In Chinese, the word "mechanics" means "the theory about the force"). Therefore, in the current paper, I tried a very different explanation (see Figure 3a), for the purpose of restoring the concept of "force", even the final result may be still the same. (Note: This is just like that in the quantum mechanics, it is too hard for me to give up the concept of the "electron orbit" by using the Copenhagen interpretation of the "electron cloud". So I re-explained the H-atom's electron wave function by using the NBP for the purpose of restoring the concept of "electron orbit", see SunQM-6s2).

In SunQM-7, I guessed that "*just like we are practically living in the 2D spherical space on the surface of a 3D ball something (i.e., a planet), we may practically live in the 3D spherical space on the surface of a 4D ball something*". This "4D ball something" is illustrated in Figure 2a. Based on this, (also based on some other diagrams in some text books, citations?), I further guessed that a Sun-massed BH (that inside this "spherical 3D space on the surface of a 4D ball something") may cause the sink-in of a small piece of (nearly flat) surface (of the spherical rθφ-3D space that on the surface of a r'rθφ-4D

ball), as shown in Figure 2b. In comparison, a Sun-massed star will cause a small and shallow dent on the surface of the "4D ball something", as shown in Figure 2a.
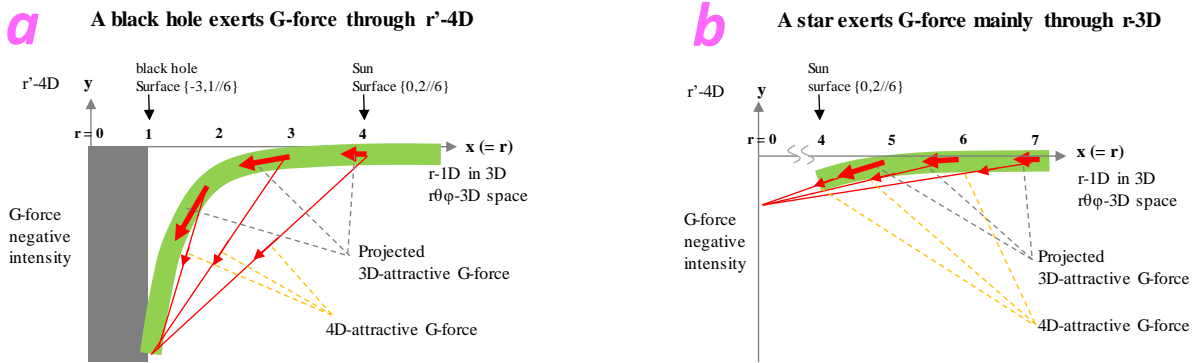

Figure 3a. Illustration of a Sun-massed BH exerts its G-force only through r'rθφ-4D space and then (indirectly) projected on to the (curved-in) rθφ-3D space at the outside of {-3,1//6}, but not directly through the (curved-in) rθφ-3D space.
Figure 3b. Illustration of a Sun-massed star exerts its G-force not only directly (and mainly) through rθφ-3D space at the outside of {0,2//6}, but also indirectly (and minorly) through r'rθφ-4D space at the outside of {0,2//6}.

        Figure 3a illustrated a brand new explanation: a BH exerts its G-force only through the r'rθφ-4D space, but not directly through the spherical rθφ-3D space. (Note: the r' dimension is the 4th dimension beyond a regular rθφ-3D space). In the xy-plot (of Figure 3a), x axis (i.e., the straight line, not the curve line) represents either the r-1D of a spherical rθφ-3D space, or the whole spherical rθφ-3D space itself (that has not been further curved by a BH or a star); the y axis (also the straight line) represents either the r'-1D (i.e., the 4th dimension) of a r'rθφ-4D space, or the negative G-force intensity (in both 3D and 4D space). (Note: Why I chose to use the negative G-force intensity $|\vec{F}| \propto \frac{-1}{r^2}$ rather than the normal $|\vec{F}| \propto \frac{1}{r^2}$ in Figure 3? Because the downward curve of $\frac{-1}{r^2}$ (that caused by the black hole's super strong G-force or the super heavy mass) in Figure 3a apparently (and intuitively) correlates to the sunk-in of a small piece of (originally nearly flat) surface (of the spherical rθφ-3D space that on the surface of a r'rθφ-4D ball) in Figure 2b that caused by the same black hole's heavy mass). The green curved thick-line in Figure 3a represents either the G-force's negative intensity (in both spherical rθφ-3D space and r'rθφ-4D space), or the whole curved (or bended) spherical rθφ-3D space itself (that is curved by the existing of a BH, like that Einstein had proposed, the higher mass density, the higher curvature in the nearby space it will be).
        Inside a BH (i.e., when r ≤ 1 in Figure 3a), the super strong G-force of the BH not only bent the out-going photon 100% backward in the spherical rθφ-3D space, but also bent the out-going graviton (or the G-force itself) 100% backward in the spherical rθφ-3D space, so that the G-force line in the (curved) spherical rθφ-3D space no longer escape to the r > 1 spherical rθφ-3D space (as shown in figure 3a). Then, how the rθφ-3D space at outside the BH (or at r > 1) get the black hole's G-force? Here I proposed that it is through the 4th dimension. Notice that in Figure 2a, a G-force can exert from point A to point B through a spherical rθφ-3D space through the arc-shaped $\overset{\frown}{AB}$ line, while the same G-force can also exert from point A to point B through r'rθφ-4D space is through the straight-line-shaped $\overline{AB}$ line, (note: in Figure 2a, if the distance between A and B becomes too short, then $\overset{\frown}{AB}$ becomes infinitely equal to $\overline{AB}$). Similarly, in Figure 3a, the three red thin-lines illustrated the G-force exerts through r'-1D (through the straight line in the r'rθφ-4D space, or inside the 4D ball), and cross-sect on the green curve (i.e., the curved spherical surface of this 4D ball), and thus projected a 4D G-force onto the curved spherical surface of this 4D ball (as represented by the three red thick-line-arrows in Figure 3a). Notice that the surface of this 4D ball actually is a spherical rθφ-3D space that is further curved by the black hole's mass (represented by the green curved thick-line). In this way, in the curved-in (or the sunk-in) spherical rθφ-3D space at outside of a Sun-massed BH with the size of {-3,1//6}, it does feel the exertion of the G-force (from the BH), but not directly from the escaped G-force in the curved-in

spherical rθφ-3D space (because the G-force does not escape from this curved-in spherical rθφ-3D space). It is the G-force that exerted in the 4th dimension of the r'rθφ-4D space that projected back to the curved-in spherical rθφ-3D space.

In comparison, for a regular Sun-massed star, at the size of {0,2//6} with r = 6.96E+8 meters, it does not have the black hole's 100% bend-back effect at its surface, so it does not stop the out-propagating photon, nor the out-propagating graviton, and it can exert its G-force to Sun's outside space directly through the (minorly curved-in) spherical rθφ-3D space. Because it has very little curvature for the spherical rθφ-3D space at the outside of the Sun, that means, the arc-shaped $\overarc{AB}$ line in Figure 2a practically equals to the straight-line-shaped $\overline{AB}$ line. Then, its G-force from the r'rθφ-4D space is practically equals to (or overlapped to, or indistinguishable, or is the same as) its G-force from the (minorly curved-in) spherical rθφ-3D space, (see Figure 3b).

Here, I'd like to use "**space density**" to describe the curvature of the space near by a black hole: the higher the curvature, the denser the space will be. (Note: Also see SunQM-7s2's section-XI).

I-h.   A spherical rθφ-3D Schrodinger equation/solution may reflect a spherical r'rθφ-4D Schrodinger equation/solution at the north (or south) pole (in a small surface region)

In SunQM-6s4, I proved that a spherical 3D Schrodinger equation/solution can be used to describe any 3D point-centered (force, mass, energy, etc.) field. Furthermore, here, we can use a spherical 3D Schrodinger equation/solution (e.g., the Schrodinger equation for H-atom), with a fixed r, a full φ range ($-\pi \leq \varphi \leq +\pi$), and a small θ range ($0 \leq \theta \leq \delta\theta$, notice that this become a small area at the north pole of a 2D spherical surface, as shown in the point A area in Figure 4), to describe a point-centered (force, mass, energy, etc.) field in a θφ-2D space. In other words, we may can use a spherical 3D Schrodinger equation/solution at the north pole spherical surface with very small area (see the "A" circular red patch on the spherical surface in Figure 4) to describe a point-centered (force, mass, energy, etc.) field in a spherical θφ-2D space. (Notice that if the surface area → 0, the spherical 2D space becomes a flat rφ-2D space).

On the other hand, we may can use the same spherical 3D Schrodinger equation/solution (e.g., the Schrodinger equation for H-atom), with a fixed r, a small φ range ($0 \leq \varphi \leq \delta\varphi$), and a small θ range at θ = π/2 (i.e., $-\delta\theta \leq (\theta - \pi/2) \leq \delta\theta$), to describe a (force, mass, energy, etc.) field in a flat xy-2D space (or a δθδφ-2D space, when δφ → 0, and (δθ - π/2) → 0). In other words, we may can use the same spherical 3D Schrodinger equation/solution at the equator with a very small surface area (see the "B" squared blue patch on the spherical surface in Figure 4) to describe a (force, mass, energy, etc.) field in a flat xy-2D space.

Similarly, I guessed that a point-centered spherical 3D Schrodinger equation/solution (e.g., the Schrodinger equation for H-atom) may correlate to a point-centered spherical 4D Schrodinger equation/solution at the north pole region, while a flat xyz-3D Schrodinger equation/solution may correlate to a point-centered spherical 4D Schrodinger equation/solution at the 4D equator region. (Note: Also see SunQM-7s2's section-VIII for more discussion on the similar topic).

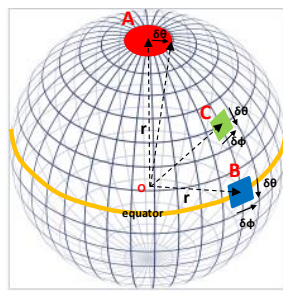

Figure 4. To illustrate that a spherical 3D Schrodinger equation/solution can be used to describe either a point-centered rφ-2D field (as shown at the point A in the red region) or a flat xy-2D field (as shown at the point B in the blue region).

II.   The possible origin of the lightspeed (and the constancy of the lightspeed) in our 3D universe

During my undergraduate study (1978 ~ 1982, Fudan university), I learned that our universe may be a closed spherical 3D space. Here is the same description in Giancoli's text book [41]: "*If the universe had a positive curvature, the universe would be closed, or finite in volume ... There is no boundary or edge in such a universe. The universe is all there is. If a particle were to move in a straight line in a particular direction, it would eventually return to the starting point – perhaps eons of time later*". Since then (or since I learned the theoretical physics), there are several life-long questions in my mind. One of them is, if that "the speed of light is constant in our universe" is correct, then what to make "the speed of light is constant in our universe" to be an axiom in the modern physics? What is the real physical reason behand it? During years of 2014 ~ 2015, after my biophysicist career was ended, and after became a new citizen scientist, while searching and initial trying for several scientific research topics (in the fields of theoretical physics and mathematical biophysics), I believed that I got a brilliant idea to answer this question.

Based on the Newtonian mechanics (with some basic Bohr-QM), for a planet (with the total mass m) that orbiting around Sun (with the total mass M), its gravitational attractive force F_g balanced out the centrifugal force F_c, and makes the planet to rotate around the Sun (with the orbital radius r_n , and the orbital speed v_n),

$$F_g = \frac{GMm}{r_n{}^2} \text{ , } F_c = m\frac{v_n{}^2}{r_n} \text{ , } F_g = F_c \text{ , } \frac{GMm}{r_n{}^2} = m\frac{v_n{}^2}{r_n} \text{ , or } v_n = \sqrt{\frac{GM}{r_n}} \qquad\qquad \text{eq-1}$$

Notice that in eq-1, the orbital speed $v_n = \sqrt{\frac{GM}{r_n}}$ is independent of the mass of the object that is moving in this orbit. This means, no matter it is a planet, or a space dust, or even an H-atom, as long as they are doing the orbital motion in the same orbit (around the Sun), they have the exact same orbital speed. For example, in the {2,6//6}o orbital shell space, either the dwarf planet Pluto, or many other smaller dwarf planets, or even a space dust, they have (roughly) the same orbital speed (assuming that they have the same orbital r_n and in the same Bohr-QM). In other words, they all feel that the orbital speed as a constant!

Now let's combine above two concepts (i.e., the 4D space and the constant v_n) together, by assuming that our universe is a spherical rθφ-3D space on the surface of a r'rθφ-4D ball something, (Note: The "4D space" in this paper is the true 4D space, and it has nothing to do with the time. It is not Einstein's "4D spacetime"), and by assuming that the eq-1 kind of relationship also exist in this r'rθφ-4D space,

$$v_{n,4D} = \sqrt{\frac{GM}{r'_n}} \qquad\qquad \text{eq-2}$$

where r' is the radius in 4th dimension, and $v_{n,4D}$ is the circular orbital speed in a point-centered r'rθφ-4D space (that equivalent to a straight line linear movement in the spherical rθφ-3D space). Then, eq-2 means that regardless of its mass, any objects in the circular orbital shell (that is our universe) in a r'rθφ-4D space has the same 4D orbital speed. This is equivalent to say, relative to a point-centered r'rθφ-4D space, for all objects (including an H-atom, a space dust, a star, a galaxy, a supercluster of galaxy, etc.) in our universe (i.e., in a spherical surface of the a r'rθφ-4D ball), they all feel that the $v_{n,4D}$ orbital speed as a constant. Then, I believed that ==this $v_{n,4D}$ orbital speed is the speed of light in our 3D universe==! In other words, we may can say that "==**the lightspeed is the intrinsic 4D orbital speed**==". If this is correct, then we may have found the origin of the constancy of the lightspeed in our 3D space. (Note: After you read both SunQM-7s1 and SunQM-7s2, you will have much better understanding why it is).

If this is correct, then there may have several ways that how this r'rθφ-4D ball space looks like:

1) Just like (in the rθφ-3D space) in our Solar system, there is a huge massed Sun at the center of the rθφ-3D ball space, and surrounded by one (or more) minor massed spherical shells (that separated with each other, like Asteroid belt in the {1,8//6}o orbital shell and the Kuiper belt in the {2,6//6}o orbital shell, etc.), in the r'rθφ-4D ball space, there might be a huge massed

"4D-Sun" at the center, and surrounded by one (or more) minor massed (separated) spherical shells, and one of them is our universe (a spherical rθφ-3D space);

2) Just like (in the rθφ-3D space) inside our Sun, in the r-1D dimension, it can be divided into many (continued, not separated, onion-like) orbital shell spaces, in the r'rθφ-4D ball space, there might be many (onion-like) concentric spherical shells that continued along the 4th dimension r', and one of them is our universe (a spherical rθφ-3D space);

3) Just like a spherical soap bulb (in the rθφ-3D space), in the r'rθφ-4D ball space, there might be a single minor massed "soap bulb", and it is our universe (a spherical rθφ-3D space), (see Appendix B for more detailed discussion). Note: An alternative description of this model is: As long as our universe has enough mass density in a limited sized 3D space, it may automatically bend the 3D space 100% backward, so that the 3D space become a closed space (like a black hole). (Note: other scientists must have proposed this before, need citation here).

4) Or, it is simply as I mentioned in SunQM-7: "*just like we are practically living in the 2D spherical space on the surface of a 3D ball something (i.e., a planet), we may practically live in the 3D spherical space on the surface of a 4D ball something*". After all, these are the reasons that why in SunQM-7, I guessed that "*our universe may should be a positive curved 3D space, with the circumference of ~ 9E+9 light-years. This means, just like we are practically living in the 2D spherical space on the surface of a 3D ball something (i.e., a planet), we may practically live in the 3D spherical space on the surface of a 4D ball something*".

        In 2018, I figured out that inside the Sun (that has an onion-like structure for the temperature radial distribution), one "onion" shell (at the orbital radius r_n and that has the same temperature T_n) can be treated to be a spherical θφ-2D "universe" (see in SunQM-3s8's section-IV). In this θφ-2D "universe", all matter waves propagate in the same "universal speed" (that equals to the orbital v_n that directly correlates to the temperature T_n). If this description is correct, then the definition of our 3D universe may should be that "**the whole rθφ-3D space that all photons can reach**", because our 3D universe has the intrinsic constant lightspeed c that correlates to a constant "4D orbital velocity" and "4D temperature" in a 4D ball space.

        Note: In a (static) rθφ-3D space, I guessed that the θ-1D and the φ-1D are naturally in RF (or the global energy minimum state) to form a θφ-2D space. Similarly, in a (static) r'rθφ-4D space, I guessed that the r-1D, θ-1D and the φ-1D are naturally in RF (or the global energy minimum state) to form a rθφ-3D space.

III. Hypothesis: a group of (large number) random direction/phase "4D thermal oscillators" forms a massed particle that localized in our 3D universe, and a group of (small number) unified direction/phase "4D thermal oscillators" forms a massless photon that un-localized in our 3D universe

        If my guess in section II is correct, then besides we see that all photons have the lightspeed of c, what does this "intrinsic 4D orbital speed" (i.e., equivalent to the lightspeed) do in the normal matter in our spherical rθφ-3D space? Here is my hypothesis (or guesses, and they are cited as guess-1 through guess-10):

1) According to the observed data (see wiki "Universe", "*At the largest scale, galaxies are distributed uniformly and the same in all directions …*"), the mass in our 3D universe can be treated as that it is (roughly) evenly distributed (at the largest scale).

2) In SunQM-2, I said that "*All atoms inside Sun are pretty much localized even they are doing thermal motion. The limited mean free path makes atoms unable to do the (free) precession movement for long time. **So inside the Sun it is the collection of matter waves (of all atoms) that doing the RF**. For a specific atom, at the end of its free path it collides with a 2nd atom, the 1st atom's original motion is stopped, but its matter wave is transferred to the 2nd atom, and the 2nd atom carries this matter wave (now it is a virtual matter wave) on its free path until it collides with the 3rd atom and transfer this virtual matter wave to the 3rd atom. The Sun has countless of atoms, and each atom carries (and transfers) several matter wave mode simultaneously (to different direction), so the collection of matter waves form RF effect*". In this description, let's degenerate the macro r-1D, and only think the macro θφ-2D (in a macro rθφ-3D space). Thus, in a macro rθφ-3D space, inside the Sun, within any one specific orbital shell space (relative to the center of the Sun), all those (countless) matter

waves are doing RF orbital motion (inside the macro θφ-2D spherical space), and with the constant orbital speed. Notice that this phenomena (i.e., the orbital speed inside Sun only depends on the orbital r) also caused that the temperature inside the Sun only depends on how close it to the center of the Sun (i.e., how small the orbital r is), and it further caused me to discover that the orbital speed inside the Sun is the origin of the temperature inside the Sun (see SunQM-3s8's section-IV).

3) We can directly use this explanation for a r'rθφ-4D space. In a point-centered r'rθφ-4D space, inside a 4D orbital shell space (that is a spherical rθφ-3D space), all those (countless) matter waves are doing RF orbital motion (inside this spherical rθφ-3D space), and with the constant orbital speed of $v_{n,4D}$ (that equivalent to the lightspeed in the rθφ-3D). Because of the RF, these matter waves are propagating in all random directions in the spherical rθφ-3D space. In other words, all "intrinsic 4D orbital speed" (i.e., equivalent to the lightspeed) are propagating in all random directions (±r, ±θ, ±φ, or any combination of them) in the rθφ-3D space. Therefore, from the largest scale (i.e., our whole universe), and in view of the wave mechanics, the 4D gravitational attractive force caused the countless 3D matter waves to do RF motion in the 4D orbital shell space (i.e., in this spherical rθφ-3D space) at the speed of $v_{n,4D}$, or at the speed of light in our 3D universe.

4) Notice that the above explanation is in view of the wave mechanics (and from the largest scale) to see what the $v_{n,4D}$ is doing in our 3D universe. Then in view of particle mechanics (and from the smallest scale), what we will see that what the $v_{n,4D}$ is really doing in our 3D universe? I guessed that it is the "==4D thermal motion==" of each massed particle in the 3D space.

5) Here is a new concept: for each massed particle (or each massed "elementary Fermions", like neutron, electron, quark, etc.) in the 3D space, there is a group of intrinsic "4D thermal motions" associated for it. This "4D thermal motion" can also be described by the regular simple harmonic oscillation [42], [43]. The maximum speed of this intrinsic "4D thermal motion" (i.e., when the kinetical energy is maximum and the potential energy is zero) is the $v_{n,4D}$ (i.e., equivalent to the lightspeed in 3D). Notice that this is the oscillation in 4D, although we don't directly see it in our 3D. In 3D, we only see the massed particle. In other words, ==this one group of "4D thermal motions" is localized in our 3D (or represented in our 3D) as a massed particle==, and I assumed that this group of many 4D oscillations forms the total size as that of this massed particle, (e.g., we may can treat a single neutron has the combination of many (micro) "==4D thermal oscillators=="). Then, similar as in the Guess-2 (that in a 3D thermal motion, we degenerate r-1D and simplify it to be a θφ-2D thermal motion), for a (group of micro and random) 4D thermal motions, let's degenerate r'-1D. Thus, a group of (micro) random oscillators oscillate in 4D space (that we don't see the 4D part) is simplified as they are (virtually) oscillating in the rθφ-3D spherical space (that we still cannot see they in 3D, but we do know each one virtual oscillation has the random motion in the combination of ±r, ±θ, ±φ directions in our 3D space), and what we can see in our 3D space is that once these random oscillations grouped together as one chunk, they presented as a massed particle (but we don't see the 3D micro virtual oscillation part). Then, at the end of each one directional motion of the oscillation (of the 4D thermal oscillator), its (virtual) matter wave is transferred to the next 4D thermal oscillator (in the front position of this motion direction), and thus this matter wave propagates forward (virtually). Then, with countless of micro 4D thermal oscillators (that are doing the micro random 4D thermal motion) in the rθφ-3D spherical space (i.e., in our universe), there are countless of (virtual) matter waves propagates (in lightspeed) in all random directions simultaneously, and, this formed the complete RF of the (virtual) matter waves in the rθφ-3D spherical space (on the spherical surface of a 4D ball space, i.e., in our universe). (Notice that this description is almost the copy of the Guess-2, except the dimension is increased by one, from a 3D space to a 4D space).

6) Then, for a massed particle, because it is made of a group of (large numbered) random direction and random phase micro "4D thermal oscillators", its averaged "macro" motion speed that projected in the rθφ-3D spherical space (i.e., in our universe) is much lower than the lightspeed (although each micro "4D thermal oscillator" has the thermal motion speed of the light speed). (Note: See several calculational examples in SunQM-7s2's sections IV and IX).

7) Then, for the massless particle photon (that is one kind of "elementary Bosons"), I assumed that it is made of a group of (small numbered) "4D thermal oscillators" with all the micro 4D thermal oscillational directions unified, plus with all the micro 4D thermal oscillational phases synchronized, so that when projected in the rθφ-3D spherical space (i.e., in our

universe), this group of unified micro "4D thermal oscillators" gains the "macro" speed of lightspeed c, and become un-localized in the 3D space. In this way, we can say that the $v_{n,4D}$ is directly carried over by the particle itself (or carried by the photon itself as the lightspeed), so that it becomes the true (a group of unified) "4D thermal motions" that propagate all over the rθφ-3D spherical space (on the spherical surface of a 4D ball space, i.e., in our universe). In this case, it can be directly seen as a particle in 3D (i.e., as a particle of a photon) and this photon particle propagates in the straight line in 3D space with the speed of light. Then, there are countless photons in our universe that are propagating in all (random) directions simultaneously (and all in the speed of light), and this reflects that there are countless (macro) matter waves that are doing RF motion in the rθφ-3D spherical space (on the spherical surface of a 4D ball, i.e., in our universe). And, the collection of these (macro) matter waves still comes from the collection of the virtual micro "3D thermal oscillators" that projected from the micro "4D thermal oscillators".

8) For other kind of massless "elementary Bosons" (like the gluons, etc.), they still need to use the localized "4D thermal motion" to describe.

9) Similar as that the constant $v_{n,3D}$ orbital speed inside the Sun is the origin of the temperature (at r_n) inside the Sun (see SunQM-3s8's section-IV), we may can say that the constant (macro) $v_{n,4D}$ orbital speed inside one surface shell of the 4D ball space correlates to a "4D temperature" in a (macro) 4D ball (onion-like) space (at a fixed r' in the 4th dimension). In other words, the random directional (macro) RF motion with $v_{n,4D}$ orbital speed inside the a spherical rθφ-3D space on the surface of a 4D ball (i.e., the random directional propagation of all photons in our 3D universe) actually reflects the "4D temperature" in a 4D ball space (at a fixed r' in the 4th dimension). In other words, ==in a (onion-like) 4D ball space, the orbital shell space in which our 3D universe located has a "**4D temperature**" of lightspeed c.==

10) Figure 5 illustrated a potential well of a (quantum mechanical) harmonic oscillator (that can be used in either 1D, or 2D, or 3D, or 4D spaces) [44]. We can use it to represent a "4D thermal oscillator" that is doing the "4D thermal motion" in a 4D ball space. In an onion-like 4D ball space, we can suppose that our universe (i.e., a 3D spherical space, or a 4D orbital single shell space) is located at the nth 4D orbital shell space, then there could exist other $(n-1)^{th}$, or $(n+1)^{th}$ 4D orbital shell spaces that in (concentric and spherical) parallel with our n^{th} 4D orbital shell space. This means, there might be other "3D universes" that are in (spherical) parallel with our 3D universe. Furthermore, if the Newton's law and the quantum mechanics in 3D space is also similar in the 4D ball space, then, due to our n^{th} 4D orbital shell space has the orbital speed of lightspeed c, then, under the formula of $v_n = \frac{v_1}{n}$, the $(n-1)^{th}$ 4D orbital shell space may should have the orbital speed (and/or "4D temperature") higher than the lightspeed c, and the $(n+1)^{th}$ 4D orbital shell space may should have the orbital speed (and/or "4D temperature") lower than the lightspeed c.
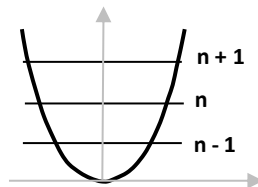

Figure 5. Illustrating a potential well of a (quantum mechanical) harmonic oscillator (that can be used in either 1D, or 2D, or 3D, or 4D spaces).

IV.   The projection of a group of "4D thermal oscillators" in a 3D space not only may be the origin of a 3D mass particle, but also may be the origin of the …

Moved to SunQM-7s2.

Conclusion

　　Using the Schrodinger equation/solution, I may can display the space formation from 1D to 2D, and to rθφ-3D. The origin of the lightspeed (and the constancy of the lightspeed) in our 3D universe may can be explained as that it comes from the macro "4D orbital motion" and the micro "4D thermal oscillation". Because we now can explain the origin of the lightspeed and the origin of the constancy of the lightspeed, this in turn will support the correctness of the two axioms in the modern physics: "the lightspeed is the maximum effective speed in our universe", and "the speed of light is constant in our universe".

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[33]   Yi Cao, SunQM-6s9: Reformulating Schrodinger Equation/Solution to Show Its r-1D Reversed-Diffusion Character for Solar System's {N,n} QM Structure Formation (Drafted in January 2020). https://vixra.org/pdf/2312.0101v1.pdf (submitted on 2023-12-19)

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[36] 周世勋, 量子力学教程, (Shi-Xun Zhou, Quantum Mechanics Tutorial) 1979 edition, p37, Fig-8.

[37] John S. Townsend, A Modern Approach to Quantum Mechanics, 2nd ed., 2012. p357, Fig-10.5.

[38] 赵凯华,陈熙谋, 电磁学（上册）, 1978, 第一版, p9, eq-1.3.

[39] 褚圣麟，原子物理学，1979年6月第1版，p27， eq-1.

[40] Douglas C. Giancoli, Physics for Scientists & Engineers with Modern Physics, 4th ed. 2009, p565, eq-21-2.

[41] Douglas C. Giancoli, Physics for Scientists & Engineers with Modern Physics, 4th ed. 2009. p1208.

[42] Douglas C. Giancoli, Physics for Scientists & Engineers with Modern Physics, 4th ed. 2009, p378, Fig-14-11.

[43] C. Kittel, W.D.Knight, M.A.Ruderman, Mechanics, (Berkeley Physics Course Vol. 1, 1973), 陈秉乾 等 翻译, 力学, 1979年2月第1版, p275.

[44] David J. Griffiths, "Introduction to Quantum Mechanics", 2nd ed., 2015, p58, Fig-2.7.

Note: A series of SunQM papers that I am working on:
SunQM-4s4: More explanations on non-Born probability (NBP)'s positive precession in {N,n}QM. (in drafting since 2020)
SunQM-7s2: Relativity and non-linear {N,n} QM … (part-2, drafted in June 2024).
SunQM-8: {N,n} QM and the condensed matter physics … (drafted in Jan. 2024).
SunQM-9s1: Addendums, Updates and Q/A for SunQM series papers. (in drafting since 2019).

Note: Major QM books, data sources, software I used for SunQM series papers study:
Douglas C. Giancoli, Physics for Scientists & Engineers with Modern Physics, 4th ed. 2009.
David J. Griffiths, Introduction to Quantum Mechanics, 2nd ed., 2015.
Stephen T. Thornton & Andrew Rex, Modern Physics for Scientists and Engineers, 3rd ed. 2006.
John S. Townsend, A Modern Approach to Quantum Mechanics, 2nd ed., 2012. (Figure 9.11, Figure 10.5)
Wikipedia at: https://en.wikipedia.org/wiki/
(Free) online math calculation software: WolframAlpha (https://www.wolframalpha.com/)
(Free) online spherical 3D plot software: MathStudio (http://mathstud.io/)
(Free) offline math calculation software: R
Microsoft Excel, Power Point, Word.
Public TV's space science related programs: PBS-NOVA, BBC-documentary, National Geographic-documentary, etc.
Journal: Scientific American.

Note: I am still looking for endorsers to post all my SunQM papers (including the future papers) to arXiv.org. Thank you in advance!
So far, my identity (for the {N,n} QM development) is: a former lecturer of Fudan University, and a (10 years closed-door, 2014 ~ 2024) citizen scientist of California.

Note: With my 35 of SunQM papers that have been posted out so far, I believe that the framework of the {N,n} QM has been fully established. It is clear now that the {N,n} QM description is suitable not only for the mass field, but also for the force field (or the energy field, etc.). Thus, my (10 years of closed-door) research phase on the {N,n} QM will end (most likely in the summer of 2024). After that, I will re-write the SunQM papers (~ 36 of them) in form of a text book. The initial plan is, 1) Try to formally publish all ~36 of SunQM papers as the original version (version-1, or version 2018) if possible; 2) Using ~ 2 years, to brief (by re-writing) all ~36 of SunQM papers (as version-2, or version 2025), the main purpose is to unify the nomenclature and the description, compress the total words from over 400,000 to less than 200,000, (and publish it if possible), make it ready for the text book writing; 3) Using 2 ~ 4 years, to write a Bohr-QM based {N,n} QM text book with ~ 100,000 words (as version-3, for college and high-school students), formally publish it if possible, and may make a few online video lectures; 4) Using 2 ~ 4 years, to add Schrodinger-equation-QM based {N,n} QM into the version-3 text book with final ~ 200,000 words (as version-4), formally publish it if possible, and may make a few online video lectures. It may take me total 6 ~10 years (2024 ~ 2035, semi-retired) to finish all the work. I may go back to Shanghai to do this work.

Appendix A. Maybe we should re-name |n=3,l=0..2> as |n=3,n"=3..1>

After the careful studying (see [37], and see Figure 1j), I realized that for n = 2, the $a_0^{3/2} R_{2,1}$ curve has one peak, so it can be treated as a n"=1 wave function, while $a_0^{3/2} R_{2,0}$ curve has two peaks (one positive and one negative), so it can be treated as a n"=2 wave function. (Note: in {N,n//q} QM, while n' always means the high-frequency n quantum number, n" can be used to refer any temporarily n quantum number). Similarly, for n = 3 (see Figure 1k), the $a_0^{3/2} R_{3,2}$ curve has one peak, so it can be treated as a n"=1 wave function; $a_0^{3/2} R_{3,1}$ curve has two peaks (one positive and one negative), so it can be treated as a n"=2 wave function; and $a_0^{3/2} R_{3,0}$ curve has three peaks (two positive and one negative), so it can be treated as a

n"=3 wave function. Thus we may can re-write |n=3,*l*=0..2> as |n=3,n"=3..1> , re-write |n=2,*l*=0..1> as |n=2,n"=2..1> , and, re-write |n=1,*l*=0> as |n=1,n"=1>. (Note: I present this because I have never seen any QM text book wrote in this way. If other scientist had already showed this result, readers please let me know).

Then, what is the advantage to use n" (in comparison with using *l*)? If the same orbital shell has the attractive force (in a G/RFg-force field), then the |n=3,*l*=0> state has higher state energy than the |n=3,*l*=2> state. Then, using |n=3,n"=3> versus |n=3,n"=1> for the *l* sub-shell makes more sense (than using |n=3,*l*=0> versus |n=3,*l*=2>), because it follows the rule that the higher the quantum number n", the higher the QM state energy it will be (same as the higher the n, the higher state energy it will be for the attractive force field). In this case, (i.e., under the same orbital shell that has the attractive force in a G/RFg-force field), the nLL QM mode has the lowest QM state energy (in the same orbital shell).

Oppositely, if the same orbital shell has the repulsive force (in a E/RFe-force field), then the |n=3,*l*=0> state has the lower state energy than that of the |n=3,*l*=2> state, so the *l* is the better quantum number than the n", because it follows the rule that the lower the *l* quantum number, the lower the QM state energy. In this case, (i.e., under the same orbital shell has the repulsive force in a E/RFe-force field), the nL0 QM mode has the lowest QM state energy (in the same orbital shell).

Here are some (related) examples:

1) In the orbital shell of {2,2//6}o, due to the same orbital shell has the attractive force in a G/RFg-force field, the four objects (Jupiter, "Greeks", "Trojans", and "Hildas", see SunQM-4s1's Fig-9) should have the lowest orbital shell energy, then it should be described as that they are all in the nLL QM state. (Notice that they are doing the (quasi) "face-to-face tidal-locked orbital binary motion").

2) For the two electrons (inside a ⁴He atom), they are in the same {-12,1//6}o orbital shell (see SunQM-7's Table-1). Due to the same orbital shell has the repulsive force in a E/RFe-force field, the two electrons should have the lowest orbital shell energy, and it should be described as that they are both in the nL0 QM state. (Notice that they are doing the "face-opposite-face locked binary orbital motion" in φ-1D bi-direction that eventually transformed to be a θ-1D orbital uni-directional motion, see SunQM-6s8's Fig-5). If we use a higher n quantum number (e.g., n=2, or |n=2,*l*=1,m>) to describe these two electrons' motion (inside a ⁴He atom), then the φ-1D bi-directional "face-opposite-face locked binary orbital motion" should be described by the |2,1,±1> nLL QM state (with the NBP positive/negative peaks at the equator), and the transformed θ-1D orbital uni-directional motion should be described by the |2,1,0> nLL QM state (with the NBP positive/negative peaks at the two poles (not at the equator), and represents the spin up/down electrons).

3) For a neutron-proton binary (inside either a ⁴He nucleus, or a ³He nucleus, or a ³H nucleus), both neutron and proton may be in the same {-16,7//6}o orbital shell (see SunQM-6s10's section-II-14b). Due to the same orbital shell has the attractive force in a residue S/RFs-force field, the neutron and proton should have the lowest orbital shell energy, then it should be described as that they are both in the nLL QM state. (Notice that they are doing the true "face-to-face tidal-locked orbital binary motion").

4) For the two same sub-structures (i.e., two neutron-proton binaries) inside a ⁴He nucleus, both are (assumed) doing the orbital motion in the {-15,1//6}o orbital shell (around the four nucleons' reduced mass center, see SunQM-6s10's section-II-14e), dominated by the two protons' same orbital shell E/RFe repulsive force, they should have the lowest orbital shell energy, and they should be described as that they are both in the nL0 QM state. (Notice that they are doing the "face-opposite-face locked binary orbital motion" in φ-1D bi-direction that eventually transformed to be a θ-1D orbital uni-directional motion, see SunQM-6s10's Fig-1, so that the |2,1,0> state's positive/negative NBP peaks at the two poles represent the two binaries).

5) For the two different sub-structures (i.e., one neutron-proton binary, one proton singlet) inside a ³He nucleus, both sub-structures are (assumed) doing the orbital motion in the {-15,1//6}o orbital shell (around the three nucleons' reduced mass center, see SunQM-6s10's section-II-14d). Dominated by the two protons' same orbital shell E/RFe repulsive force, they should have the lowest orbital shell energy, and they should be described as that they are both in the nL0 QM state. (Notice that they are doing the "face-opposite-face locked binary orbital motion" in φ-1D bi-direction that eventually transformed to be a θ-1D orbital uni-directional motion, see SunQM-6s10's Fig-1, so that the |2,1,0> state's positive/negative NBP peaks at the two poles represent the two binaries).

6) For the two different sub-structures (i.e., one neutron-proton binary, one neutron singlet) inside a ³H nucleus, both sub-structures are (assumed) doing the orbital motion in the {-15,1//6}o orbital shell (around the three nucleons' reduced mass center, see SunQM-6s10's section-II-14c). Dominated by the two sub structures' same orbital shell residue S/RFs attractive

force, these two sub structures should have the lowest orbital shell energy, then it should be described as that they are both in the nLL QM state. (Notice that they are doing the true "face-to-face tidal-locked orbital binary motion").

7) After all, we see that the "face-to-face tidal-locked orbital binary motion" should be described with |n,*l*,<mark>+**m**</mark>> nLL QM state, the "face-opposite-face locked binary orbital motion" in φ-1D bi-direction should be described with |n,*l*,<mark>±**m**</mark>> nLL QM state (with the NBP positive/negative peaks at the equator), and the transformed θ-1D orbital uni-directional motion should be described by the |n,*l*,0> nLL QM state (with the NBP positive/negative peaks at the two poles (not at the equator)).

Appendix B.   If our 3D universe is a spherical 3D space on the surface of a r'rθφ-4D ball, then, for a star, the collective gravitational force it subjected from all other stars in the whole 3D universe (with total mass m) is equivalent to that there is a point mass of m located at the r' distance away (where r' is the radius of this r'rθφ-4D ball)

(Note: This is a citizen-scientist-leveled deduction. I worked out this in 2016).

First, suppose that there is a circular mass ring with radius r and with total mass of m (that evenly distributed on the ring), now we want to know that for each tiny mass fragment δm (on the ring), what is the total attractive gravitational force it subjected from the rest mass on the ring? To solve this problem, in a φ-1D circular line space, the mass density of the ring $D = m/(2\pi r)$, so the tiny mass fragment δm (that correlates to the δφ on the ring) is calculated as $\delta m = D(r\,\delta\varphi)$. The total mass of the whole ring is calculated as $\int_0^{2\pi} D(r\,\delta\varphi) = \int_0^{2\pi} \frac{m}{2\pi r} r\,d\varphi = m$, and the mass center is located at the center of this mass ring (in a rφ-2D space). Then for each tiny mass fragment $\delta m = D(r\,\delta\varphi) = \frac{m}{2\pi r}(r\,\delta\varphi) = m\frac{\delta\varphi}{2\pi}$ on the ring, the rest total mass on the ring is $(m - \delta m)$, and its position is equivalent at the center of the ring (when the $\delta m \to 0$). So now the question becomes: a point mass of $(m - \delta m)$ at the center of the ring exerts gravitational force on the δm at r distance. It should be calculated as:

$$dF = G\frac{(m-\delta m)(\delta m)}{r^2} = G\frac{m\cdot\delta m-(\delta m)^2}{r^2} \rightarrow \frac{Gm}{r^2}\left(\frac{m\cdot d\varphi}{2\pi}\right),\qquad\qquad\qquad eq\text{-}3$$

when $\delta\varphi \to 0$ and omitting $(\delta m)^2$. The physical meaning of eq-3 is, for a mass ring with radius r and with total mass = m, the gravitational attractive force between a small fragment of the ring and the rest part of the whole ring is equivalent to a point mass of m applying its gravitational force on another point mass of $\left(m\frac{d\varphi}{2\pi}\right)$ at a distance r. Then, after integrate this dF for the whole ring,

$$F = \int_0^{2\pi} dF = \int_0^{2\pi} \frac{Gm}{r^2}\left(\frac{m}{2\pi}\right) d\varphi = \frac{Gmm}{r^2}\qquad\qquad\qquad eq\text{-}4$$

The physical meaning of eq-4 may be (correct me if I am wrong), for a mass ring with radius r and with total mass = m, the collection of the gravitational attractive force between each small fragment of the ring is equivalent to a point mass of m applying its gravitational force on another point mass of m at a distance r.

Second, the above question in φ-1D space can be easily extended into a θφ-2D space: suppose that a total mass of m is evenly distributed in a θφ-2D spherical space (on the surface of a rθφ-3D ball with a fixed radius r), for each tiny mass fragment δm (on the 2D surface), what is the total attractive gravitational force it is subjected from all the rest mass on the 2D surface? Now, in the θφ-2D spherical space, the mass density $D = \frac{m}{4\pi r^2}$, the tiny mass fragment $\delta m = D(r^2\cdot\sin\theta\,d\theta d\varphi)$, the total mass in the whole θφ-2D spherical space is calculated as $\int_0^\pi \int_0^{2\pi} D(r^2\sin\theta)\,d\theta d\varphi = \int_0^\pi \int_0^{2\pi} \frac{m}{4\pi r^2}(r^2\sin\theta)\,d\theta d\varphi = m$, and its position is equivalent at the center of a rθφ-3D ball. Then, for each tiny mass fragment $\delta m = D(r^2\sin\theta\,d\theta d\varphi)$ on the surface of this rθφ-3D ball (i.e., in the θφ-2D spherical space), the rest total mass on the θφ-2D sphere is $(m - \delta m)$, so

that the question becomes: a point mass of $(m - \delta m)$ at the center of a 3D ball exerts gravitational force on the δm at r distance. It should be calculated as:

$$dF = G\frac{(m-\delta m)(\delta m)}{r^2} = \frac{Gm}{r^2}\left(D(r^2 \sin\theta \, d\theta d\varphi)\right) = \frac{Gm}{r^2}\left(\frac{m}{4\pi}\sin\theta \, d\theta d\varphi\right) \qquad \text{eq-5}$$

The physical meaning of eq-5 is, for a massed 2D spherical surface with radius r and with total mass = m, the gravitational attractive force between a tiny fragment of the 2D spherical surface and the rest part of the whole 2D spherical surface is equivalent to a point mass of m applying its gravitational force on another point mass of $\left(\frac{m}{4\pi}\sin\theta \, d\theta d\varphi\right)$ at a 3D distance r. Then, after integrate this dF for the whole 2D spherical surface,

$$F = \int dF = \int_0^\pi \int_0^{2\pi} \frac{Gm}{r^2}\left(\frac{m}{4\pi}\sin\theta \, d\theta d\varphi\right) = \frac{Gmm}{r^2} \qquad \text{eq-6}$$

The physical meaning of eq-6 may be (correct me if I am wrong), for a massed 2D spherical surface with the fixed 3D radius r and with total mass = m, the collection of the gravitational attractive force between each small fragment of the 2D spherical surface is equivalent to a point mass of m applying its gravitational force on another point mass of m at a 3D distance r. (Note: This is also the reason for SunQM-3's Fig-1b "*All rest objects in the same shell (B, B') interacting with object A is equivalent to the interaction of a point object with mass ≈ Σm at origin O to this object A*").

Third, the above question in θφ-2D space can be easily extended to a spherical 3D space: suppose that a total mass of m is evenly distributed in a spherical rθφ-3D space (on the surface of a r'rθφ-4D ball something with a fixed radius r' in the 4th dimension, see the illustration in Figure 2a), for each tiny mass fragment δm (on the spherical 3D surface), what is the total attractive gravitational force it subjected from the rest mass on the same spherical 3D surface (i.e., from all the rest mass in our universe)? Based on the formulas in wiki "N-sphere", or wiki "3-sphere", we should be able to calculate out the mass density (by dividing the total mass m to the total surface area of a r'rθφ-4D ball). As a citizen scientist, although I don't know how to do the real calculation, I believed (based on the previous result) that on the surface of a r'rθφ-4D ball (i.e., in the spherical rθφ-3D space, or in our universe), the collection of the gravitational attractive force between each small fragment of the spherical rθφ-3D surface (on the surface of a 4D ball with r') is equivalent to a point mass of m applying its gravitational force on another point mass of m at a distance r', or something similar like

$$F = \frac{Gmm}{(r')^2}, \text{ (where r' is a radius in the 4th dimension of a r'rθφ-4D ball space)} \qquad \text{eq-7}$$

The physical meaning of eq-7 may be (correct me if I am wrong), if our universe is a spherical rθφ-3D space that on a surface of a r'rθφ-4D ball something (with the r' as at 4th dimension), and if the total mass m of our universe can be treated as evenly distributed in the spherical rθφ-3D space, then, for each object in our universe (e.g., a galaxy, or a star, etc.), the collective gravitational force it subjected from all other galaxies (or stars) in the whole universe is equivalent to that there is a point mass of m located at the r' distance away.

Appendix C.   A macro-world's example of "face-opposite-face locked binary orbital motion" in φ-1D bi-direction

(Note: This should go to SunQM-6s10's section-IV). We can use Saturn-moon system as the example of "face-opposite-face locked binary orbital motion" in φ-1D bi-direction in the macro world. In this case, Saturn and all of its prograde orbital motion moons can be treated the first sub-structure (that is doing the "face-to-face tidal locked orbital motion binaries" within the sub-structure), and then the major retrograde moon Phoebe (or plus all other minor retrograde moons that have the spin anti-parallel to Saturn's spin) can be treated the second sub-structure. Then, between these two sub-structures, they are doing the "face-opposite-face locked binary orbital motion" in φ-1D bi-direction in the macro world. However, this specific "face-opposite-face locked binary orbital motion" in φ-1D bi-direction has not been transformed into a θ-1D uni-

directional orbital motion. So, to prove the "face-to-face plus face-opposite-face two-level orbital motion" model, we still need to find the observable example of "face-opposite-face locked binary orbital motion" in φ-1D bi-direction that eventually transformed into a θ-1D uni-directional orbital motion (with the spin direction aligned with the orbital motion direction) in the macro-world.

Appendix D.   The different views between the wave mechanics and the particle mechanics on the "face-to-face plus face-opposite-face two-level orbital motion"

(Note: This should go to SunQM-6s10). In SunQM-6s10's section-III, I mentioned that "*by comparing* Y(*l*=1,*m*=+1) $= -\sqrt{\frac{3}{8\pi}} e^{i\varphi} \sin\theta$, with, Y(*l*=1,*m*=-1) $= \sqrt{\frac{3}{8\pi}} e^{-i\varphi} \sin\theta$, *the matter wave must move simultaneously in both opposite ±m (or ±φ) directions. For matter waves, it is not difficult to understand that a simultaneous ±φ motion means a steady state wave. But, for two physical objects, how to explain the simultaneous ±φ motion as the NBP?*". Now I figured out how to answer this question under the "face-to-face plus face-opposite-face two-level orbital motion" model. For the "face-opposite-face locked binary orbital motion" in φ-1D bi-direction (with the anti-parallel spin, see in SunQM-6s10's Fig-1d), after transformed to be a θ-1D orbital uni-directional motion, it can be treated as that in the φ-1D, at φ = 0 position, it is indeed in the steady state (the φ = 0 position is fixed, it is always nuclear spin-down), and the particle is switched between particle-1 (that equivalent to the positive peak of the steady state matter wave) and particle-2 (that equivalent to the negative peak of the same steady state matter wave). Similarly, at φ = π, it is also in the steady state (the φ = π position is fixed, it is always nuclear spin-up), and the particle is switched between particle-2 (that equivalent to the negative peak of the same steady state matter wave) and particle-1 (that equivalent to the positive peak of the steady state matter wave). This is just like that for a steady state wave, at the wave amplitude peak position (with this position fixed), the wave is always switched between the positive peak and the negative peak.

In other words, in the wave mechanics, the two equations "Y(*l*=1,*m*=±1) $= \mp\sqrt{\frac{3}{8\pi}} e^{\pm i\varphi} \sin\theta$" means a steady state (of a two bi-directional waves in φ-1D), while in the particle mechanics, it means the "face-opposite-face locked binary orbital motion" bi-directional motion in φ-1D that eventually transformed into a θ-1D uni-directional orbital motion.

Then, the imaginary number sign "i" that in the Y(*l*=1,*m*=±1) equations may mean that in φ-1D at the φ = 0 position (or at the φ = π position), the switching process between particle-1 and particle-2 not only involves a motion process within the φ-1D space, but also involves a motion process outside of the φ-1D space (i.e., in the θ-1D space, also see the similar explanation in SunQM-2).

This explanation may can be understood more intuitively by plotting the Euler formula of a complex number $z = x + iy = |z|(\cos\varphi + i\sin\varphi)$ and its conjugate $\bar{z} = x - iy = |z|(\cos\varphi - i\sin\varphi)$, with different Euler angle φ. After forcing a complex number to be a real number, (that is, after a xy-2D circular motion is degenerated into x-1D oscillational motion), the φ has to be either φ = 0 (i.e., at $i^0 = i^4 = 1$), or φ = π (i.e., at $i^2 = -1$), when viewed in x-1D, an oscillational particle at φ = 0 or φ = π may have the same physical property, but when viewed in xy-2D (or in complex space), it may has two different physical properties (like one spin-down, one spin-up). The key point of this discussion is, if one object at two positions (in one space) seems to be the same, at a higher dimension, it may show up the different properties (that we are not able to see in the lower dimension).

Appendix E.   Change SunQM-7's Table-1 into two tables, one in size-only, another one in rest mass (or the rest energy) only.

(Note: This should go to SunQM-7). Result:

1) Table 1 (the size-only table) showed no problem for all size range (from N = 25 down to N = -24). So it should be valid, and can be used as a standard table for the reference.

2) Table 2 (the mass-only table) may only be good for the size range smaller than the H-atom {-12,1//6} size. Extending the mass to larger than {-12,1//6} gave unmatched result, (due to that after changing the unit column 5 in Table 2 from MeV/c^2 to kg in column 17, it does not match the observed data in column 18). Hence, Table 2 (the mass-only table) may only OK for the nuclear force (or S/RFs-force) range. It does not match to the G/RFg-forced mass field's known data.

3) In SunQM-6s2, I guessed that "*a 3D wave packet should have the size about one wavelength*", also see SunQM-6s4's Fig-6c. I guessed that by using $= hf = h\frac{c}{\lambda} = \frac{hc}{2r}$, we may can use the size-table (Table 1) to estimate the low-f photon's energy (based on its size, or the wavelength, or the frequency f). I tried it, although no good result has been obtained so far.

4) Here is one way that how to use Table 1 and Table 2. As shown in SunQM-6s3's Appendix A Example-1, "==*The **base-size** of a 656.1 nm photon's 3D wave packet* has diameter = 656.1 nm, or, r ≈ 3.28E-7 meters==", it has a {N,n} size at {-10,3//6}. "==*The **core size** of a 656.1 nm photon's 3D wave packet* may can be estimated to be at around {-21,3//6} with r = 2.57E-24 meters== ... (because) *a 656.1 nm photon has (the base-frequency)* Δf_{ph} = 4.57E+14 Hz, energy E = h Δf_{ph} = 3.03E-19 J = 1.89 eV. Check SunQM-7's Table-1, a 1.89 eV/c^2 particle may stay in {-21,2//6}o QM state, and may have the size of {-21,3//6}". "==*The **maximum size** of a 656.1 nm photon's 3D wave packet*== was estimated to be r = 2.7E+10 meters (see SunQM-6s2's section II-i for the calculation) ... at around {1,2//6}".

Table 1. Size-only (unit: meter), Using proton's r = 8.40E-16 meters (at {-15,1//6} = {-16,6//6} size) as the standard anchor. (Note: Size calculation used the outer-edge (n+1) side value of the n shell).

Force	label	{N,n//6}	n = "n state" or "n shell" or "n orbit space"											
			1	2	3	4	5	6	7	8	9	10	11	12
N =		-24	3.31E-29	7.44E-29	1.32E-28	2.07E-28	2.98E-28	4.05E-28	5.30E-28	6.70E-28	8.27E-28	1.00E-27	1.19E-27	
"N period" or "N	particle sub-	-23	1.19E-27	2.68E-27	4.76E-27	7.44E-27	1.07E-26	1.46E-26	1.91E-26	2.41E-26	2.98E-26	3.60E-26	4.29E-26	
"-1" Force ?	eV/c^2	-22	4.29E-26	9.65E-26	1.72E-25	2.68E-25	3.86E-25	5.25E-25	6.86E-25	8.68E-25	1.07E-24	1.30E-24	1.54E-24	
	particle	-21	1.54E-24	3.47E-24	6.17E-24	9.65E-24	1.39E-23	1.89E-23	2.46E-23	3.13E-23	3.86E-23	4.67E-23	5.56E-23	
	eV/c^2	-20	5.56E-23	1.25E-22	2.22E-22	3.47E-22	5.00E-22	6.81E-22	8.90E-22	1.13E-21	1.39E-21	1.68E-21	2.00E-21	
	particle	-19	2.00E-21	4.50E-21	8.00E-21	1.25E-20	1.80E-20	2.45E-20	3.20E-20	4.05E-20	5.00E-20	6.05E-20	7.20E-20	
	KeV/c^2	-18	7.20E-20	1.62E-19	2.88E-19	4.50E-19	6.48E-19	8.82E-19	1.15E-18	1.46E-18	1.80E-18	2.18E-18	2.59E-18	
S/RFs force	particle MeV/c^2	-17	2.59E-18	5.83E-18	1.04E-17	1.62E-17	2.33E-17	3.18E-17	4.14E-17	5.25E-17	6.48E-17	7.84E-17	9.33E-17	
		-16	9.33E-17	2.10E-16	3.73E-16	5.83E-16	**8.40E-16**	1.14E-15	1.49E-15	1.89E-15	2.33E-15	2.82E-15	3.36E-15	
	Atom's nuclues, or,particle GeV/c^2	-15	3.36E-15	7.56E-15	1.34E-14	2.10E-14	3.02E-14	4.12E-14	5.38E-14	6.80E-14	8.40E-14	1.02E-13	1.21E-13	
		-14	1.21E-13	2.72E-13	4.84E-13	7.56E-13	1.09E-12	1.48E-12	1.94E-12	2.45E-12	3.02E-12	3.66E-12	4.35E-12	
		-13	4.35E-12	9.80E-12	1.74E-11	2.72E-11	3.92E-11	5.33E-11	6.96E-11	8.82E-11	1.09E-10	1.32E-10	1.57E-10	
E/RFe force	atom	-12	1.57E-10	3.53E-10	6.27E-10	9.80E-10	1.41E-09	1.92E-09	2.51E-09	3.17E-09	3.92E-09	4.74E-09	5.64E-09	
		-11	5.64E-09	1.27E-08	2.26E-08	3.53E-08	5.08E-08	6.91E-08	9.02E-08	1.14E-07	1.41E-07	1.71E-07	2.03E-07	
		-10	2.03E-07	4.57E-07	8.13E-07	1.27E-06	1.83E-06	2.49E-06	3.25E-06	4.11E-06	5.08E-06	6.15E-06	7.31E-06	
		-9	7.31E-06	1.65E-05	2.93E-05	4.57E-05	6.58E-05	8.96E-05	1.17E-04	1.48E-04	1.83E-04	2.21E-04	2.63E-04	
		-8	2.63E-04	5.92E-04	1.05E-03	1.65E-03	2.37E-03	3.23E-03	4.21E-03	5.33E-03	6.58E-03	7.96E-03	9.48E-03	
		-7	9.48E-03	2.13E-02	3.79E-02	5.92E-02	8.53E-02	1.16E-01	1.52E-01	1.92E-01	2.37E-01	2.87E-01	3.41E-01	
		-6	3.41E-01	7.68E-01	1.36E+00	2.13E+00	3.07E+00	4.18E+00	5.46E+00	6.91E+00	8.53E+00	1.03E+01	1.23E+01	
		-5	1.23E+01	2.76E+01	4.91E+01	7.68E+01	1.11E+02	1.50E+02	1.97E+02	2.49E+02	3.07E+02	3.72E+02	4.42E+02	
G/RFg force	collapsed Sun size	-4	4.42E+02	9.95E+02	1.77E+03	2.76E+03	3.98E+03	5.42E+03	7.07E+03	8.96E+03	1.11E+04	1.34E+04	1.59E+04	
		-3	1.59E+04	3.58E+04	6.37E+04	9.95E+04	1.43E+05	1.95E+05	2.54E+05	3.22E+05	3.98E+05	4.82E+05	5.73E+05	
		-2	5.73E+05	1.29E+06	2.29E+06	3.58E+06	5.16E+06	7.02E+06	9.17E+06	1.16E+07	1.43E+07	1.73E+07	2.06E+07	
	Sun size, Sun internal shell	-1	2.06E+07	4.64E+07	8.25E+07	1.29E+08	1.86E+08	2.53E+08	3.30E+08	4.18E+08	5.16E+08	6.24E+08	7.43E+08	
	Planet size	0	7.43E+08	1.67E+09	2.97E+09	4.64E+09	6.69E+09	9.10E+09	1.19E+10	1.50E+10	1.86E+10	2.25E+10	2.67E+10	
	Solar system, Planet orbit	1	2.67E+10	6.02E+10	1.07E+11	1.67E+11	2.41E+11	3.28E+11	4.27E+11	5.42E+11	6.69E+11	8.09E+11	9.63E+11	
		2	9.63E+11	2.17E+12	3.85E+12	6.02E+12	8.66E+12	1.18E+13	1.54E+13	1.95E+13	2.41E+13	2.91E+13	3.47E+13	
		3	3.47E+13	7.80E+13	1.39E+14	2.17E+14	3.12E+14	4.25E+14	5.55E+14	7.02E+14	8.66E+14	1.05E+15	1.25E+15	
		4	1.25E+15	2.81E+15	4.99E+15	7.80E+15	1.12E+16	1.53E+16	2.00E+16	2.53E+16	3.12E+16	3.77E+16	4.49E+16	
	between stars	5	4.49E+16	1.01E+17	1.80E+17	2.81E+17	4.04E+17	5.50E+17	7.18E+17	9.10E+17	1.12E+18	1.36E+18	1.62E+18	
		6	1.62E+18	3.64E+18	6.47E+18	1.01E+19	1.46E+19	1.98E+19	2.59E+19	3.27E+19	4.04E+19	4.89E+19	5.82E+19	
	Galaxy	7	5.82E+19	1.31E+20	2.33E+20	3.64E+20	5.24E+20	7.13E+20	9.31E+20	1.18E+21	1.46E+21	1.76E+21	2.10E+21	
		8	2.10E+21	4.71E+21	8.38E+21	1.31E+22	1.89E+22	2.57E+22	3.36E+22	4.24E+22	5.24E+22	6.34E+22	7.54E+22	
"+1" force ?	Super Cluster	9	7.54E+22	1.70E+23	3.02E+23	4.71E+23	6.79E+23	9.24E+23	1.21E+24	1.53E+24	1.89E+24	2.28E+24	2.72E+24	
		10	2.72E+24	6.11E+24	1.09E+25	1.70E+25	2.44E+25	3.33E+25	4.35E+25	5.50E+25	6.79E+25	8.22E+25	9.78E+25	
	observable universe	11	9.78E+25	2.20E+26	3.91E+26	6.11E+26	8.80E+26	1.20E+27	1.56E+27	1.98E+27	2.44E+27	2.96E+27	3.52E+27	
	Universe	12	3.52E+27	7.92E+27	1.41E+28	2.20E+28	3.17E+28	4.31E+28	5.63E+28	7.13E+28	8.80E+28	1.06E+29	1.27E+29	
		13	1.27E+29	2.85E+29	5.07E+29	7.92E+29	1.14E+30	1.55E+30	2.03E+30	2.57E+30	3.17E+30	3.83E+30	4.56E+30	
		14	4.56E+30	1.03E+31	1.82E+31	2.85E+31	4.11E+31	5.59E+31	7.30E+31	9.24E+31	1.14E+32	1.38E+32	1.64E+32	
		15	1.64E+32	3.69E+32	6.57E+32	1.03E+33	1.48E+33	2.01E+33	2.62E+33	3.33E+33	4.11E+33	4.97E+33	5.91E+33	

Table 2. Mass-only (unit = eV/c^2). Using proton = 938 MeV/c^2 as the value at {-16,5//6}o inner edge size (that equals to {-16,5//6} size), or, 1351 MeV/c^2 at {-16,5//6}o outer edge size (that equals to {-16,6//6} size), as the standard anchor, to make the up-quark to have ~1 MeV/c^2.

Category	Description	{N,n//6}	n=1	2	3	4	5	6	7	8	9	10	11	12	from MeV/c^2 to kg (5)	known kg (5)
N =		-24	1.33E-05	5.32E-05	1.20E-04	2.13E-04	3.32E-04	4.79E-04	6.52E-04	8.51E-04	1.08E-03	1.33E-03	1.61E-03	1.92E-03	5.93E-40	
"N period" or "N	particle sub-	-23	4.79E-04	1.92E-03	4.31E-03	7.66E-03	1.20E-02	1.72E-02	2.35E-02	3.06E-02	3.88E-02	4.79E-02	5.79E-02	6.89E-02	2.13E-38	
"-1" Force ?	eV/c^2	-22	1.72E-02	6.89E-02	1.55E-01	2.76E-01	4.31E-01	6.21E-01	8.45E-01	1.10E+00	1.40E+00	1.72E+00	2.09E+00	2.48E+00	7.68E-37	
	particle	-21	6.21E-01	2.48E+00	5.58E+00	9.93E+00	1.55E+01	2.23E+01	3.04E+01	3.97E+01	5.03E+01	6.21E+01	7.51E+01	8.94E+01	2.77E-35	
	eV/c^2	-20	2.23E+01	8.94E+01	2.01E+02	3.57E+02	5.58E+02	8.04E+02	1.09E+03	1.43E+03	1.81E+03	2.23E+03	2.70E+03	3.22E+03	9.96E-34	
	particle	-19	8.04E+02	3.22E+03	7.24E+03	1.29E+04	2.01E+04	2.90E+04	3.94E+04	5.15E+04	6.51E+04	8.04E+04	9.73E+04	1.16E+05	3.58E-32	
	KeV/c^2	-18	2.90E+04	1.16E+05	2.61E+05	4.63E+05	7.24E+05	1.04E+06	1.42E+06	1.85E+06	2.35E+06	2.90E+06	3.50E+06	4.17E+06	1.29E-30	
S/RFs force	particle MeV/c^2	-17	1.04E+06	4.17E+06	9.38E+06	1.67E+07	2.61E+07	3.75E+07	5.11E+07	6.67E+07	8.44E+07	1.04E+08	1.26E+08	1.50E+08	4.65E-29	
		-16	3.75E+07	1.50E+08	3.38E+08	6.00E+08	9.38E+08	1.35E+09	1.84E+09	2.40E+09	3.04E+09	3.75E+09	4.54E+09	5.40E+09	1.67E-27	
	Atom's nuclues, or,particle GeV/c^2	-15	1.35E+09	5.40E+09	1.22E+10	2.16E+10	3.38E+10	4.86E+10	6.62E+10	8.64E+10	1.09E+11	1.35E+11	1.63E+11	1.95E+11	6.02E-26	
		-14	4.86E+10	1.95E+11	4.38E+11	7.78E+11	1.22E+12	1.75E+12	2.38E+12	3.11E+12	3.94E+12	4.86E+12	5.88E+12	7.00E+12	2.17E-24	
		-13	1.75E+12	7.00E+12	1.58E+13	2.80E+13	4.38E+13	6.30E+13	8.58E+13	1.12E+14	1.42E+14	1.75E+14	2.12E+14	2.52E+14	7.80E-23	
E/RFe force	atom	-12	6.30E+13	2.52E+14	5.67E+14	1.01E+15	1.58E+15	2.27E+15	3.09E+15	4.03E+15	5.10E+15	6.30E+15	7.63E+15	9.07E+15	2.81E-21	
		-11	2.27E+15	9.07E+15	2.04E+16	3.63E+16	5.67E+16	8.17E+16	1.11E+17	1.45E+17	1.84E+17	2.27E+17	2.75E+17	3.27E+17	1.01E-19	
		-10	8.17E+16	3.27E+17	7.35E+17	1.31E+18	2.04E+18	2.94E+18	4.00E+18	5.23E+18	6.62E+18	8.17E+18	9.88E+18	1.18E+19	3.64E-18	
		-9	2.94E+18	1.18E+19	2.65E+19	4.70E+19	7.35E+19	1.06E+20	1.44E+20	1.88E+20	2.38E+20	2.94E+20	3.56E+20	4.23E+20	1.31E-16	
		-8	1.06E+20	4.23E+20	9.53E+20	1.69E+21	2.65E+21	3.81E+21	5.19E+21	6.77E+21	8.57E+21	1.06E+22	1.28E+22	1.52E+22	4.72E-15	
		-7	3.81E+21	1.52E+22	3.43E+22	6.10E+22	9.53E+22	1.37E+23	1.87E+23	2.44E+23	3.09E+23	3.81E+23	4.61E+23	5.49E+23	1.70E-13	
		-6	1.37E+23	5.49E+23	1.23E+24	2.19E+24	3.43E+24	4.94E+24	6.72E+24	8.78E+24	1.11E+25	1.37E+25	1.66E+25	1.98E+25	6.11E-12	
		-5	4.94E+24	1.98E+25	4.44E+25	7.90E+25	1.23E+26	1.78E+26	2.42E+26	3.16E+26	4.00E+26	4.94E+26	5.98E+26	7.11E+26	2.20E-10	
G/RFg force	collapsed Sun size	-4	1.78E+26	7.11E+26	1.60E+27	2.84E+27	4.44E+27	6.40E+27	8.71E+27	1.14E+28	1.44E+28	1.78E+28	2.15E+28	2.56E+28	7.92E-09	
		-3	6.40E+27	2.56E+28	5.76E+28	1.02E+29	1.60E+29	2.30E+29	3.14E+29	4.10E+29	5.18E+29	6.40E+29	7.74E+29	9.22E+29	2.85E-07	
		-2	2.30E+29	9.22E+29	2.07E+30	3.69E+30	5.76E+30	8.29E+30	1.13E+31	1.47E+31	1.87E+31	2.30E+31	2.79E+31	3.32E+31	1.03E-05	
	Sun size, Sun internal shell	-1	8.29E+30	3.32E+31	7.47E+31	1.33E+32	2.07E+32	2.99E+32	4.06E+32	5.31E+32	6.72E+32	8.29E+32	1.00E+33	1.19E+33	3.70E-04	
	Planet size	0	2.99E+32	1.19E+33	2.69E+33	4.78E+33	7.47E+33	1.07E+34	1.46E+34	1.91E+34	2.42E+34	2.99E+34	3.61E+34	4.30E+34	1.33E-02	~1.99E+30
	Solar system,	1	1.07E+34	4.30E+34	9.67E+34	1.72E+35	2.69E+35	3.87E+35	5.27E+35	6.88E+35	8.71E+35	1.07E+36	1.30E+36	1.55E+36	4.79E-01	1.99E+30
	Planet orbit	2	3.87E+35	1.55E+36	3.48E+36	6.19E+36	9.67E+36	1.39E+37	1.90E+37	2.48E+37	3.13E+37	3.87E+37	4.68E+37	5.57E+37	1.73E+01	1.99E+30
		3	1.39E+37	5.57E+37	1.25E+38	2.23E+38	3.48E+38	5.02E+38	6.83E+38	8.92E+38	1.13E+39	1.39E+39	1.69E+39	2.01E+39	6.21E+02	1.99E+30
		4	5.02E+38	2.01E+39	4.51E+39	8.02E+39	1.25E+40	1.81E+40	2.46E+40	3.21E+40	4.06E+40	5.02E+40	6.07E+40	7.22E+40	2.24E+04	1.99E+30
	between stars	5	1.81E+40	7.22E+40	1.63E+41	2.89E+41	4.51E+41	6.50E+41	8.85E+41	1.16E+42	1.46E+42	1.81E+42	2.18E+42	2.60E+42	8.05E+05	1.99E+30
		6	6.50E+41	2.60E+42	5.85E+42	1.04E+43	1.63E+43	2.34E+43	3.19E+43	4.16E+43	5.27E+43	6.50E+43	7.87E+43	9.36E+43	2.90E+07	
	Galaxy	7	2.34E+43	9.36E+43	2.11E+44	3.74E+44	5.85E+44	8.42E+44	1.15E+45	1.50E+45	1.90E+45	2.34E+45	2.83E+45	3.37E+45	1.04E+09	2.29E+42
		8	8.42E+44	3.37E+45	7.58E+45	1.35E+46	2.11E+46	3.03E+46	4.13E+46	5.39E+46	6.82E+46	8.42E+46	1.02E+47	1.21E+47	3.76E+10	2.29E+42
"+1" force ?	Super Cluster	9	3.03E+46	1.21E+47	2.73E+47	4.85E+47	7.58E+47	1.09E+48	1.49E+48	1.94E+48	2.46E+48	3.03E+48	3.67E+48	4.37E+48	1.35E+12	
		10	1.09E+48	4.37E+48	9.83E+48	1.75E+49	2.73E+49	3.93E+49	5.35E+49	6.99E+49	8.84E+49	1.09E+50	1.32E+50	1.57E+50	4.87E+13	
	observable universe	11	3.93E+49	1.57E+50	3.54E+50	6.29E+50	9.83E+50	1.41E+51	1.93E+51	2.52E+51	3.18E+51	3.93E+51	4.76E+51	5.66E+51	1.75E+15	
	Universe	12	1.41E+51	5.66E+51	1.27E+52	2.26E+52	3.54E+52	5.09E+52	6.93E+52	9.06E+52	1.15E+53	1.41E+53	1.71E+53	2.04E+53	6.31E+16	
		13	5.09E+52	2.04E+53	4.58E+53	8.15E+53	1.27E+54	1.83E+54	2.50E+54	3.26E+54	4.13E+54	5.09E+54	6.16E+54	7.33E+54	2.27E+18	
		14	1.83E+54	7.33E+54	1.65E+55	2.93E+55	4.58E+55	6.60E+55	8.99E+55	1.17E+56	1.49E+56	1.83E+56	2.22E+56	2.64E+56	8.17E+19	
		15	6.60E+55	2.64E+56	5.94E+56	1.06E+57	1.65E+57	2.38E+57	3.23E+57	4.22E+57	5.35E+57	6.60E+57	7.99E+57	9.51E+57	2.94E+21	

Note: column header row — n = "n state" or "n shell" or "n orbit space"