SunQM-1s1: The dynamics of the quantum collapse (and quantum expansion) of Solar QM {N,n} structure

Yi Cao
Ph.D. of biophysics, a citizen scientist of QM.
E-mail: yicaojob@yahoo.com

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Abstract

In this paper I study the evolution and dynamics of the Solar QM {N,n} structure. After discovered the Solar QM {N,n} structure, I immediately realized that the formation of our current Solar system was through a series of quantum collapse of pre-Sun ball's N super-shell from {6,1} to {0,1}. However, it took me quite a while to figure out what is the driving force for the quantized collapse: the collapse of {N,n=1..5}o super-shell increases the thermal pressure of {N-1,n=1..5}o super-shell and prevent it from immediate collapse. Then after some time the heat (and mass) losing in {N-1,n=1..5}o super-shell decreased its thermal pressure and trigged a new round of collapse. A switch from the cold-G r-track for N=4 and 3 super-shells to the hot-G r-track for N=1 and 0 super-shells caused a 26% of r length increase. This r-track change revealed that the Hydrogen fusion started right after {2,1}RF pre-Sun ball had formed. (The Hydrogen fusion's heat formed) ice-evap-line expended and passed Mars orbit {1,6}, and evaporated all ice mass within {1,6}RF ball and excited them to orbit {2,2}o and {2,3}o orbits. Therefore it formed the extraordinary large (ice) mass of Jupiter, and very large mass of Saturn. The original mass density as the function of r has been modeled out as D = 4.37E+28 / r^3.279 (kg/m^3). From it, I estimated that the original (ice) mass of Venus, Earth, Mars were 34×, 25×, 19× of the current Earth's mass. The original mass of Jupiter was only 10% of current one. So 90% of Jupiter's current (ice) mass was obtained from the original Venus, Earth, and Mars's orbit shells! The same model also predicted that the four undiscovered {3,n=2..5}o planets/belts will have mass around 12×, 7×, 5×, and 3× of Earth's mass. Asteroid belt is assigned to be at {1,8}o orbit. It is also interesting to see that the mass QM {N,n} structure collapse is accompanied by a heat QM {N,n} structure expansion in the Solar QM {N,n} structure dynamics.

Introduction

In the previous paper SunQM-1 [1], I quantized the Solar system's orbits (e.g., {0,2} for Sun's surface, {1,5} for Earth orbit) and established a {N,n} periodic table. In current paper (SunQM-1s1), I will present my additional discoveries and thoughts related to the Solar system QM {N,n} structure. Note: Microsoft Excel's number format is often used in this paper, for example: x^2 = x^2, 3.4E+12 = $3.4*10^{12}$, 5.6E-9 = $5.6*10^{-9}$.

I. Solar system was formed by a series of quantum collapse of pre-Sun ball from {6,1} to {5,1}, {4,1}, …down to {0,1}.

After discovered the Solar QM {N,n} structure, I immediately realized that the formation of our current Solar system was through a series of quantum collapse of pre-Sun ball's N super-shell from {6,1} to {0,1}. Wiki "Stellar evolution" and wiki "Sun" presents us the most updated views from physicists on how our Sun (and all stars) evolved. Based on that, and combined with the newly discovered Solar QM {N,n} structure, I re-write the evolution of our Solar system as following:

During a supernova explosion, the exploded matter was (quantumly) excited to a very high (potential) energy state against the G-force, and formed nebula. Then in the next stage of star forming process, the G-force of the nebula interact with the supernova's leftover black hole was not important at all. The local G-force of gas molecules attracting each other played the key role here. According to the analysis in my paper SunQM-1s2, a wandering orphan Jupiter (or even a red-dwarf) ran into a nebula, and then it was captured by this nebula. The flew-in orphan Jupiter quickly spiral-in and then superpositioned to the mass center of (a local) nebula. It formed a single-point-centered G-force field and thus became a seed for the further development of the pre-Sun ball. Driven by this point center G-force, the nebula's mass center region became more concentrated in mass and faster in spin (than the edge part). So a primitive Solar QM {N,n} structure was formed. It is pre-Sun {5,6}={6,1} with r ≈ 2E+6 AU or even bigger, and it cleared out the nebula mass outside of {6,1} probably up to {7,1}.

This {6,1} pre-Sun QM structure slowly and continuously concentrates mass to its center (driven by the G-force), and speeds up the spin (driven by the angular momentum conservation). To a certain point, the first quantum collapse of pre-Sun nebula {6,1} happened and it generated a ball-like {5,1}RF QM structure with r ≈ 56000AU, and > 99% of mass in the shell space between {5,1} and {6,1} was quickly collapsed into {5,1}RF ball, so that the space between {5,1} and {6,1} (or even bigger region) was almost completely cleared due to this collapse. Our Sun's current closest star Alpha Centauri (who is passing-by Solar system right now, current distance to Sun similar to {5,2}) was at nowhere nearby at that time.

The newly formed {5,1}RF pre-Sun ball QM structure stabilized for certain amount of time while G-force was still slowly concentrating mass to the pre-Sun center and slowly speeding up the pre-Sun ball spin. To a break point, a 2nd quantum collapse happened in pre-Sun nebula ball, and it generated a ball-like {4,1}RF QM structure with r ≈ 1500AU. Again > 99% of mass in the shell space region between {4,1} and {5,1} was quickly collapsed into {4,1}RF ball, and <1% left-over matter in the spherical space between {4,1} and {5,1} quickly disk-lized (at least for the inner Oort cloud) and then evolved to be today's Oort cloud. The disk-lization of spherically distributed leftover mass after a collapse is governed by Schrodinger equation solution (through the 1st-order spin-perturbation calculation), and I will present the accurate mathematical calculation and diagram in paper SunQM-3s1. However, while the inner Oort cloud (in orbit {4,1}, {4,2}, and {4,3} orbits) was disk-lized (or more like torus), the outer Oort cloud (in orbits {4,n=4..5}o) was poorly or even barely disk-lyzed due to the strong interaction with the interstellar wind, and relative weak Solar QM effect.

Then, the same {N,n} QM dynamics happened again and again, the pre-Sun quantumly collapsed from {4,1} to {3,1}, then to {2,1}, then to {1,1}, then to the current {0,1}, and the (<1%) leftover mass after each collapse quickly disk-lized and then formed the {3,n=2..6} undiscovered planets/belts, the {2,n=2..6} icy-planets/belt, the {1,n=2..6} rocky-planets, and empty {0,3-6} orbits. So through a series of quantum collapse of {N,n} QM structure, a pre-Sun nebula transformed into a Solar system we see today.

Moreover, this quantum collapse of our Solar QM {N,n} structure is still ongoing. 5 billion years later, Sun core {0,1} will further quantumly collapse into a white dwarf {-1,1}. For those large mass white dwarfs, they will further collapse to {-2,1} (an unknown QM structure which suppose to be relatively stable), and then to {-3,2} neutron star or {-3,1} black hole, then eventually to the possible {-4,1} and {-5,1} QM state.

So using Solar QM {N,n} structure, we can easily and naturally explain how our Solar system's was formed, and how it will further evolve in the future.

II. How the collapse of {N,n} structure become quantized?

See my paper SunQM-3 for detailed explanation. Here I summarized as below: The out-most N super-shell was stabilized by its thermal pressure. As time passed, the loosing heat (of the out-most N super-shell) decreases the thermal pressure to below a critical point, then the N super-shell collapse. The collapsed matter flying inward, most of them collided with the existing matter in the N-1 super-shell, therefore increased both the mass density and temperature in the N-1 super-shell. So it greatly increased the thermal pressure in N-1 super-shell, or stabilized N-1 super-shell from immediate collapse.

Here I plot a hypothesized picture to show a possible situation: At the initial state, the out-most N (=5) super-shell has higher of both mass density and temperature than that of N-1 (=4) super-shell just after the N+1 (=6) collapse has finished. As time passes, the out-most super-shell's temperature decreases, and its mass also gradually flying inward (driven by G-force), so that at the end, the out-most N (=5) super-shell has lower mass density and temperature than that of N-1 (=4) super-shell just before the next quantum collapse starts.

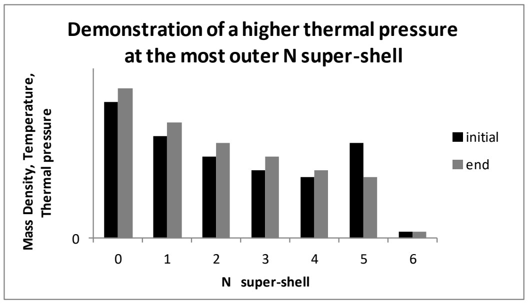

Figure 1. Demonstration of a high thermal pressure (and mass density) at the most outer N (=5) super-shell right after the quantum collapse from N=6 super shell.

III. The r between {2,1} and {-1,1} in Solar QM {N,n} is increased by ~26% due to the nuclear fusion generated heating.

From the result of section I, we know that the dynamics of Sun formation was a series of quantum collapse of pre-Sun {N,1}RF QM structure from {6,1}RF ball to {0,1}RF ball. A simple calculation of Solar QM {N,n} structure using base-5*6^ n and period factor =6 is perfectly good from {6,1} to {3,1}, and for {2,1} to {0,1}, but is interrupted at {3,1} to {2,1}, where the period factor has to be =5.33 (see Table 3 in paper SunQM-1). Pretty soon I realized that this period factor decrease must be related to the ice-line expansion after {2,1}RF ball formation, so I spent a lot of effort to model it. In August 2016, after I discovered Solar QM {N,n} structure, I noticed that the r of {N,n} is ~26% larger if using Sun core as r_1 (in comparison to using black hole's r as r_1, see Table 3 in paper SunQM-1). After 8 months study, with increased understanding of the Sun evolution dynamics, I eventually found a simplest and most reasonable explanation: just like the dislocation in a crystal, the r_n between {2,1} and {-1,1} in Solar QM {N,n} is dislocated by ~26% larger due to the nuclear fusion generated heat. Let me explain this result through simple calculation in Table 1. In column 8, I re-calculated Solar {N,n} structure solely based on an single size reference point: a Sun-mass black hole at {-3,1} that has radius = 2.95km, and set all periods factor = 6. We can see that the calculated gravity-r of {-3,2}, {2,4}, and {2,5} match r of Sun-mass neutron star, Uranus and Neptune extremely well. This clearly reveals that Sun-mass black hole {-3,1}, neutron star {-3,2}, Uranus {2,4} and Neptune {2,5} belong to the exact same {N,n//6} QM structure! If we force r of {0,2} (in column 8) to be the same as r of Sun surface by multiplying a factor (6.96E8/5.51E8≈1.264), or 26% larger, and then used it to correct the r from {-1,1} to {2,1}, then we obtain the new r of {1,3}, {1,4}, {1,5}, {1,6} (shown in column 9) that matches r of Mercury, Venus, Earth, and Mars as well as that in the Table 3 of paper SunQM-1.

This result can be best explained as that a pure G-force governed (non nuclear fusion) Solar QM {N,n} structure has {-3,1}'s r_n = 2.95 km, exactly the size of Sun-mass's black body, and this {N,n//6} QM structure can be scaled up (and down), with period factor = 6. However the heat generated by nuclear fusion (started at {2,1} for Sun) caused all r(s) between {2,1] and {-1,1} deviate out of the gravity-r-track (by increasing ~26%) . It did this by increased r_n of {2,1} by 26%, and compressed r-dimension of N=2 super-shell by ~20%. Therefore it changed N=2 's period factor from =6 to =5.33 (calculated as 5.33^2 / 6^2 = 0.79, so r_n of the period factor =5.33 is ~ 20% smaller than r_n of period factor =6)!

But once the nuclear fusion stops (for Sun it will be at {-1,1} white dwarf), the r_n will move back to the gravity-r-track by reducing ~20%.

In summary, there are two r-tracks in the Solar QM {N,n} structure quantum collapse, one is solely controlled by mass and G-force of Sun, named "gravity-r-track" (or {N,n,Cold}, shown by column 8 in Table 1). The second one is controlled by both the G-force and the heat of nuclear fusion, named "heated-r-track" (or {N,n,Hot}, shown by column 9 in Table 1). For our Sun, the heated-r-track is 26% larger than the gravity-r-track in length. So for our Solar system, its quantum collapse was first following the gravity-r-track from {6,1} down to {2,1}, then switched to heated-r-track at {2,1} and continues collapse down to {-1,1}, then will switch back to the gravity-r-track at {-1,1}. This is just like the dislocation in a crystal, the r_n between {2,1} and {-1,1} in Solar QM {N,n} were dislocated by ~26% larger due to the nuclear fusion generated heat (see Figure 2). This phenomenon should also exist in all other stars, although each star may differ in where to start dislocation, what %, and where to stop.

Table 1. Re-calculate Solar {N,n} structure based on Sun-mass black hole at {-3,1} r =2.95 km, set all periods factor =6,

NASA's data of planets			assigned N, n, period factor			black hole total n=1, using {N,n} to calc total n & r				
	mass	Sun's radius or planets' $r_{n\text{-}orbit}$	N	n	period factor	total n from Sun core	gravity-r-track, $r_{n\text{-}orbit}= n^2 r_{1\text{-}orbit}$	heated-r-track, $r_{n\text{-}orbit}$ increase 26%	gravity-$r_{n\text{-}orbit}$=	gravity-$r_{n\text{-}orbit}$=
unit	kg	m					m		AU	light year
{-5,1}			-5	1	6	1*6^(-2)	2.28E+00			
			-5	2	6	2*6^(-2)	9.10E+00			
			-5	3	6	3*6^(-2)	2.05E+01			
			-5	4	6	4*6^(-2)	3.64E+01			
			-5	5	6	5*6^(-2)	5.69E+01			
{-4,1}			-5	6	6	6*6^(-2)	8.19E+01			
			-4	2	6	2*6^(-1)	3.28E+02			
			-4	3	6	3*6^(-1)	7.38E+02			
			-4	4	6	4*6^(-1)	1.31E+03			
			-4	5	6	5*6^(-1)	2.05E+03			
black hole {-3,1}			-4	6	6	1	**2.95E+03**			
neutron star {-3,2}			-3	2	6	2	**1.18E+04**			
			-3	3	6	3	2.66E+04			
			-3	4	6	4	4.72E+04			
			-3	5	6	5	7.38E+04			
{-2,1}			-3	6	6	6	1.06E+05			
			-2	2	6	12	4.25E+05			
			-2	3	6	18	9.56E+05			
			-2	4	6	24	1.70E+06			
			-2	5	6	30	2.66E+06			
White Dwarf {-1,1}			-2	6	6	36	**3.82E+06**	**4.83E+06**		
			-1	2	6	72	1.53E+07	1.93E+07		
			-1	3	6	108	3.44E+07	4.35E+07		
			-1	4	6	144	6.12E+07	7.73E+07		
			-1	5	6	180	9.56E+07	1.21E+08		
Sun core		1.74E+08	0	1	6	216	1.38E+08	**1.74E+08**		
Sun {0,2}	1.989E+30	6.96E+08	0	2	6	432	5.51E+08	**6.96E+08**		
{0,3} corona			0	3	6	648	1.24E+09	1.57E+09		
{0,4} corona			0	4	6	864	2.20E+09	2.78E+09		
{0,5} corona			0	5	6	1080	3.44E+09	4.35E+09		
{0,6} corona			0	6	6	1296	4.95E+09	6.26E+09		
{1,2} heliosphere			1	2	6	2592	1.98E+10	2.51E+10		
Mercury	3.3E+23	5.79E+10	1	3	6	3888	4.46E+10	**5.64E+10**		
Venus	4.87E+24	1.08E+11	1	4	6	5184	7.93E+10	**1.00E+11**		
Earth	5.97E+24	1.49E+11	1	5	6	6480	1.24E+11	**1.57E+11**	0.83	
Mars	6.42E+23	2.28E+11	1	6	6	7776	1.78E+11	**2.25E+11**	1.20	
Jupiter	1.898E+27	7.78E+11	2	2	6	15552	7.14E+11		4.79	
Saturn	5.68E+26	1.428E+12	2	3	6	23328	1.61E+12		10.8	
Uranus	8.68E+25	2.974E+12	2	4	6	31104	**2.85E+12**		19.2	
Neptune	1.02E+26	4.506E+12	2	5	6	38880	**4.46E+12**		29.9	
Pluto	1.46E+22	5.913E+12	2	6	6	46656	6.42E+12		43.1	
{3,2}			3	2	6	93312	2.57E+13		172	
{3,3}			3	3	6	139968	5.78E+13		388	
{3,4}			3	4	6	186624	1.03E+14		690	0.011
{3,5}			3	5	6	233280	1.61E+14		1077	0.017
Inner Oort, start 2000AU			3	6	6	279936	**2.31E+14**		1552	0.025
Inner Oort, start 2000AU			4	2	6	559872	9.25E+14		6206	0.098
Inner Oort, end 20000AU			4	3	6	839808	2.08E+15		1.40E+04	0.22
outer Oort, start 20000AU			4	4	6	1119744	3.70E+15		2.48E+04	0.39
outer Oort,end 50000AU			4	5	6	1399680	5.78E+15		3.88E+04	0.61
outer Oort,end 100000AU			4	6	6	1679616	**8.32E+15**		5.59E+04	0.88
{5,2} Alpha Centauri			5	2	6	3359232	3.33E+16		2.23E+05	3.5
{5,3}			5	3	6	5038848	7.49E+16		5.03E+05	7.9
{5,4}			5	4	6	6718464	1.33E+17		8.94E+05	14.1
{5,5}			5	5	6	8398080	2.08E+17		1.40E+06	22.1
{5,6}			5	6	6	10077696	3.00E+17		2.01E+06	31.8

Just like the annual growth rings of a tree trunk recorded the climate history of that tree growth even thousands years ago, or DNA's SNP and its distribution among people can tell us the history of early human migration, the {N,n} orbits in Solar system recorded the history of how pre-Sun nebula quantum collapsed to the current Sun, and r of {N,n,Cold} vs. r of {N,n,Hot} recorded the history of when the pre-Sun ball started the hydrogen fusion during a series of collapse.

One important conclusion from Table 1 is: both Uranus and Neptune are at the right gravity-r tract. I will use this result to estimate the original mass of Jupiter and Saturn (in Table 2).

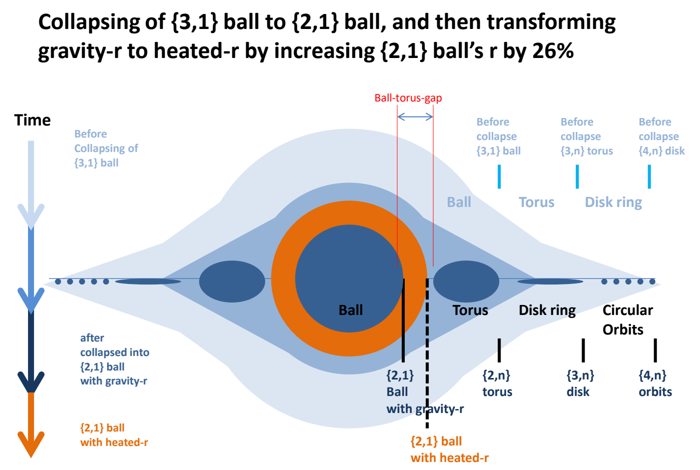

Figure 2. Demonstration of transforming gravity-r to heated-r by increasing {2,1}RF ball's r by 26%.

IV. The ignition of hydrogen fusion evaporated ice in {2,1}RF ball and caused the formation of the extra-large planet Jupiter at {2,2}o orbit.

So now we can have a more detailed picture about how our Solar system {N,n} QM structure was evolved: When pre-Sun {N,n} structure quantumly collapsed from {6,1} to {2,1}, the temperature and pressure at its center (probably within size of {-3,1}) increased so high that it ignited Hydrogen fusion. The Hydrogen fusion ball quickly expanded (probably to the size close to {0,1}), generated tremendous amount of heat, and caused {2,1} QM structure increased its size by 26% in r. At this moment, the Solar QM {N,n} structure switched from the gravity-r-track to the heated-r-track within the range of {2,1}. This means that the {2,n=1..5}o orbits (which was gradually forming during this time period) decreased its r-dimension space by ~20%. To accommodate that, the {2,n=1..5}o QM system adjusted its structure by moving {2,2}o and {2,3}o orbits outward a little bit to today's Jupiter and Saturn's orbits, and leaving {2,4}o, {2,5}o orbits barely touched (same as today's Uranus and Neptune's orbits), and this is the best explanation for the result of my modeling in Table 1. That is how today's {2,n=1..5}o orbits formed in our Solar system.

During this time, all ice matter inside the {2,1}RF ball was melted, evaporated, and flew outward, and captured mostly by Jupiter and some by Saturn. Or, in QM's terminology, ice matter in the ground state {2,1}o was excited by the heat of hydrogen fusion, and transitioned to the excited states at {2,2}o and {2,3}o. So this process formed an extraordinary large Jupiter with its major ice-mass come from inside {2,1}RF ball. This process also formed a very large Saturn with its major ice-mass also come from inside {2,1}RF ball.

Then the quantum collapse of N super-shell continued for the Solar QM {N,n} structure, from {2,1} down to {1,1}, {0,1}, and then to {-1,1}, a white dwarf with r = 4.83E+6 m. For our Sun, the nuclear fusion reaction stopped at white dwarf, and its hot body will gradually cool down and shrink the size. Eventually its size (in r) will decrease by 20%, back to the gravity-r-track.

V. Reconstitute the original icy-mass distribution along r from the gravity-r track {1,1} shell to {2,6} shell.

Note: both section V and section VI try to estimate the original mass of Solar QM orbit for {1,n=1..5}o, {2,n=1..5}o, {3,n=1..5}o and {4,n=1..5}o shells. Section V is my early work that was done before I discover the rule that "all mass between r_n and rn+1 belong to orbit n", so everything (including the shell volume) was done by manual adjusting.

Section VI is after I discovered the rule that "all mass between rn and rn+1 belong to orbit n", so it uses much simpler math. The purpose I show my old estimation is that it helps readers to understand my new calculation in section VI.

My original purpose was (with the help of Solar QM {N,n} model) to understand why Mars has such small mass, and Jupiter has such large mass. In my earlier work, I constructed the mass density vs. r plot (data and figure is not shown here, using the same method as for Table 2 construction), and found that the mass density for shell spaces of Venus, Earth, Jupiter, Saturn, Uranus, and Neptune (except Mars) are consistent with a log-log linear fitting line. But if combining Mars' mass and orbit shell space volume to that of Jupiter, then the averaged mass density looks normal. That trigs me to think that most mass of Jupiter may actually come from Mars' shell space. Mars' relative good circular orbit (eccentricity=0.094), low inclination (1.9°), not high axis tilt (25°), all suggest that the old-Mars had collected most mass in Mars shell space, and got pretty good averaged values. So the stealing of mass from Mars to Jupiter most likely happened after (or during) Mars formation.

As shown in Table 1, our Solar QM {N,n} structure has r = 1.78E+11 meters for gravity-r {2,1}o orbit, and r = 2.25E+11 meters (or 1.26x larger) for heated-r {2,1}o orbit. In the discussion of section IV, I suggested that the heat of hydrogen fusion evaporated all icy matter within {2,1}RF pre-Sun ball, and moved it to {2,2}o and {2,3}o orbits. I like to know in the early days when {2,1} was just formed and still in gravity-r-track, how much ice mass was originally in {2,1}RF ball, in {2,2}o and {2,3}o orbits. So here I present one of my modeling results on reconstitution of the original icy-mass distribution along r from the gravity-r{2,1} shell to {2,6} shell (shown in Table 2).

Let's first simplify our model for the original ice-mass reconstitution in Table 2:

1) The pre-Sun contained only three kind of mass components, gas (hydrogen), ice, and rock.
2) The mass density of all three matters was continuously decreasing from the center to the edge of the pre-Sun ball.
3) In the mass density vs. r plot (not shown), the 1st deviation of the curve should be continues either inside or outside the RF ball, but discontinues at the ball surface (that separates the ball from the outer disk orbits)
4) In shell space between {1,1} and {3,1}, the mass was overwhelmingly dominated by ice, also only ice was re-distributed from inside {2,1}RF ball to shell space of {2,1} and {3,1} caused by the heat of Hydrogen fusion, so we ignored the gas and rock during calculation.

The following is the explanation of how I did the calculation for Table 2:

5) In Table 2, the first 11 columns were copied from Table 1. From column 12 to column 15, I calculated the mass density for each spherical shell space. In column 16 I fit the density vs. r plot to a log-log linear standard line to get the original ice mass density. In column 19 I calculated the original mass (mostly ice) of each shell in unit of Earth-mass.

6) To calculate the shell space volume, I need to determine the border of each shell space. After tried many different methods for modeling, I decided to use a simplest, although not very accurate method (from column 12 to 15 in Table 2):

inner border-r_n = avg(r_n, r_{n-1})
outer border-r_n = avg(r_n, r_{n+1})
gap between borders (n+1 & n) = (r_{n+1}'s inner border) – (r_n's outer border).
shell space volume ΔV= 4/3*π *[outer border]^3 - 4/3*π *[inner border]^3
pre-adjusted mass density per shell = mass of planet / ΔV

Then in Figure 3, I plot out the "pre-adjusted Density per shell" (column 15) vs. r, which is the CURRENT {2,n} mass density per shell (in blue circles).

Note: for the outer border of r_n at {1,6}, instead of avg($r_{\{1,6\}}$, $r_{\{2,2\}}$), it is calculated as inner-border-r_6 + [(inner-border-r_6) - (inner-border-r_5)] = 5.44E+12 + (5.44E+12 - 3.66E+12) = 7.22E+12 m, so that there is a gap (=8.83E+12 m in column 14) between {1,6} shell's outer border and {2,2}'s inner border. This gap is ignored in mass density calculation. Many months after this work, I realized that this is because {N,6}o orbit covers shell space from {N,6} to {N,7}, while {N+1,1}o orbit covers shell space from {N+1,1}={N,6} to {N+1,2}={N,12}. Now I named it as the"ball-torus-7-11-gap effect", or "ball-torus-gap" (see Figure 2), meaning immediately after a {N+1,1}RF pre-Sun ball collapsed into a {N,1}RF pre-Sun ball, the

{N,1} ball and the {N,n=2..6} torus completely disconnect in a way that the mass in orbit space of {N-1,n=7..11}o is completely cleared out. Notice that the orbits of {N-1,n=7..11}o are not exist at this time. {N,1}RF ball only generates the new orbits of {N,n=1..5}o, not {N-1,n=1..5}o. It is after another collapse, the newly formed {N-1,1}RF pre-Sun ball will generate the new orbits of {N-1,n=7..11}o.

7) Then in Figure 3, I add a 2nd curve as "adjusted to original-ice-Density per shell" (shown in column 16). Here I manually adjust the values of {2,2} and {2,3} mass density to make them in the expected straight line. Meanwhile, the mass density of {2,1} is calculated as the total mass of super-shell {2,n=1…6} minus that of {2,n=2…6}, and it has to be adjusted to in-line at the same time, so it is calculated as the sum of the left over mass in column 17, then divided by the shell space volume of {2,1}={1,6} ball. Therefore, the total (ice) mass in {2,1} ball and in {2,2}, {2,3} shells is unchanged before and after adjustment, only the distribution is changed. or, 5.49E-9 = {[(3.08E-10 - ***5.00E-11***) * (4/3*π *(1.16E+12 ^3 - 4.46E+11 ^3))] + [(1.42E-11 - ***3.00E-12***) * (4/3*π *(2.23E+12 ^3 - 1.16E+12 ^3))] } / { 4/3*π *(4.46E+11) ^3} where bold-italic numbers (in Table 2) are manually adjusted values. Values in column 16 are the final estimated original mass density for each shell space.

8) Originally I was trying to fit the mass density vs. r plot to an exponential curve. But after several tries, I realized a linear fitting of log-log plot is much better. This gives a fitting equation
D = a * r^k , or, log(D) = k log(r) + log(a)
where D is mass density in a spherical shell of a orbit {N,n}. So I used this equation for modeling (in Table 2). However, I am still not able to give a good explanation of its physics meaning at this moment.

9) The four standard points of the expected log-log line are based on:
9a) The first two points come from Uranus and Neptune, both still have (or at least close to) the original mass, so they can be used as the standard points at one end of the expected straight line;
9b) The 3rd point come from the estimated total mass of Kuiper belt (obtained by other scientists, see wiki "Kuiper belt", it was between 0.1×, or 30× of Earth's mass, here I used 5× of Earth mass at r of {2,6} shell).
9c) The 4th point come from the estimated total mass of the outer Oort cloud (obtained by other scientists, see wiki "Oort claud") is ~5× of Earth mass, so I put 3E+25 kg at {4,5} orbit.
So, according to this expected line, this method give only a very rough estimation of the original mass density of shell spaces between {2,1} and {2,3}.

10) Then the original mass density (in column 16) is used to calculate the original ice mass (in column 18) for each original shell space.

11) All r_n calculation in columns 12-19 of Table 2 using gravity-r (in column 8, so columns 9-11 has been grayed out). The reason I use black hole (rather than Sun core) as total n=1 is that the {N,n,Cold} (not the {N,n.Hot}) should be used to estimate the original (ice) mass for {2,n=1…6} shells.

Table 2. Reconstitute the original icy-mass distribution along r for {2,n=1..6} shells. Note: Kuiper belt's mass was adjusted to be 5× of Earth's mass here.

NASA's data of planets			assigned N, n, period fac			black hole total n=1, use {N,n} calc total n & r					use gravity-r-track								
	mass	Sun's radius or planets' $r_{n\text{-orbit}}$	N, Sun{1,1}	n	period factor	total n from Black hole	gravity-r-track, $r_{n\text{-orbit}}=n^2 r_{1\text{-orbit}}$	heated-r-track, $r_{n\text{-orbit}}$ increase 26%	$r_{n\text{-orbit}}=$	$r_{n\text{-orbit}}=$	inner border-r_n=avg(r_n, r_{n-1})	outer border-r_n=avg(r_n, r_{n+1})	gap between borders (n+1 & n)	pre-adjusted Density per shell	adjusted to orginal-ice-Density per shell	ice-mass re-distributed	original mass at r_n	mass ratio	
unit	kg	m					m	m	AU	ly	m	m	m	kg/m^3	kg/m^3	kg	kg	kg/kg	
black hole {-3,1}			-3	1	6	1	2.95E+03												
Sun core		1.74E+08	0	1	6	216	1.38E+08	1.74E+08											
SUN	1.99E+30	6.96E+08	0	2	6	432	5.51E+08	6.96E+08											
Mercury	3.30E+23	5.79E+10	1	3	6	3888	4.46E+10	5.64E+10											
Venus	4.87E+24	1.08E+11	1	4	6	5184	7.93E+10	1.00E+11											
Earth	5.97E+24	1.49E+11	1	5	6	6480	1.24E+11	1.57E+11	1.05										
Mars	6.42E+23	2.28E+11	1	6	6	7776	1.78E+11	2.25E+11	1.51			4.46E+11	0		5.49E-09		2.04E+27	1.074	of Jupiter
Jupiter	1.90E+27	7.78E+11	2	2	6	15552	7.14E+11		4.79		4.46E+11	1.16E+12	0	3.08E-10	***5.00E-11***	1.59E+27	3.08E+26	0.162	of Jupiter
Saturn	5.68E+26	1.428E+12	2	3	6	23328	1.61E+12		10.8		1.16E+12	2.23E+12	0	1.42E-11	***3.00E-12***	4.48E+26	1.20E+26	0.211	of Saturn
Uranus	8.68E+25	2.974E+12	2	4	6	31104	2.85E+12		19.2		2.23E+12	3.66E+12	0	5.48E-13	5.48E-13		8.68E+25		
Neptune	1.02E+26	4.506E+12	2	5	6	38880	4.46E+12		29.9		3.66E+12	5.44E+12	0	2.17E-13	2.17E-13		1.02E+26		
Kuiper	***2.99E+25***	5.913E+12	2	6	6	46656	6.42E+12		43.1		5.44E+12	*7.22E+12*	8.83E+12	3.30E-14	3.30E-14		2.99E+25	5.0	Earth mass
For section VI																			
{3,2}			3	2	6	93312	2.57E+13		172		*1.61E+13*	4.17E+13			*3.96E-16*		***1.20E+26***	*20.1*	*Earth mass*
{3,3}			3	3	6	139968	5.78E+13		388		*4.17E+13*	8.03E+13			*2.90E-17*		***5.40E+25***	*9.0*	*Earth mass*
{3,4}			3	4	6	186624	1.03E+14		690	0.011	*8.03E+13*	1.32E+14			*4.06E-18*		***3.00E+25***	*5.0*	*Earth mass*
{3,5}			3	5	6	233280	1.61E+14		1077	0.017	*1.32E+14*	1.96E+14			*1.10E-18*		***2.40E+25***	*4.0*	*Earth mass*
Inner Oort, start 2000AU			3	6	6	279936	2.31E+14		1552	0.025	*1.96E+14*	5.78E+14							
Inner Oort, start 2000AU			4	2	6	559872	9.25E+14		6206	0.098	*5.78E+14*	1.50E+15							
Inner Oort, end 20000AU			4	3	6	839808	2.08E+15		13964	0.22	*1.50E+15*	2.89E+15							
outer Oort, start 20000AU			4	4	6	1119744	3.70E+15		24824	0.39	*2.89E+15*	4.74E+15							
outer Oort,end 50000AU			4	5	6	1399680	5.78E+15		38788	0.61	*4.74E+15*	7.05E+15			*8.99E-24*		***3.00E+25***	*5.0*	*Earth mass*
outer Oort,end 100000AU			4	6	6	1679616	8.32E+15		55854	0.88	*7.05E+15*	8.32E+15							
											9.36E+15								
sum mass {2,n=1...6}	2.69E+27																2.68E+27		

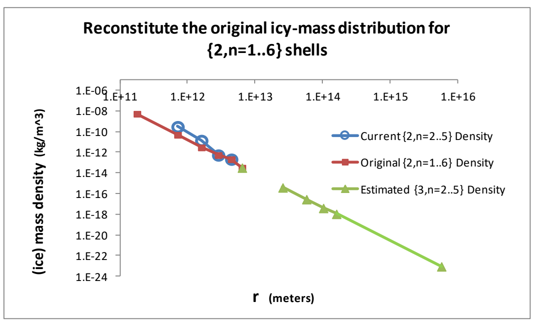

Figure 3. Reconstitute the original icy-mass distribution along r for {2,n=1..6} shells.

Result & discussion (of Table 2):

1) Jupiter has only ~16% mass obtained from its own shell space (column 19), and ~84% (hydrogen & ice) mass actually come from {1,6} shell space!

2) Even Saturn has only ~21% mass obtained from its own shell space (column 19), and ~79% (hydrogen & ice) mass come from {1,6} shell space!

3) After Sun started hydrogen fusion, and after the ice-evap-line expanded to the current {1,8} shell, the {1,6} shell space lost almost all of its 2.04E+27 kg of (hydrogen & ice) mass (see column 18, about 1.07× of Jupiter's mass, see column 19), and 78% went to Jupiter, 22% went to Saturn! Only 6.42E+23 / 2.04E+27 = 0.03% of rocky mass was left in {1,6} shell space and formed today's Mars!

4) This model is easier to be understand when reader knows the answer: it assumes > 90% of mass in shells of {1,6}, {2,2}, {2,3} is hydrogen/ice, and hydrogen/ice can be re-distributed as the ice-evap-line expand. It should be point out that in the real mass density calculation, the volume of shell space {1,6} is replaced by the {2,1} ball.

5) Now, a more accurate explanation for this is that after {3,1}RF pre-Sun ball collapsed to {2,1}RF structure, ~99% of mass (mostly ice) in {2,n=2..6} super-shell flew into {1,n=2..6} super-shell. After colliding with the existing mass in N=1 super-shell, most of flew-in (ice) mass stopped in N=1 super-shell, so it increased the mass density and temperature in N=1

super shell, The greatly increased thermal pressure in N=1 super-shell prevented the immediate collapse of {1,n=2..6} super-shell, so the quantum collapse of {3,1} to {2,1} was finished, the {2,1}RF ball was stabilized (at least for the moment). After {2,1}RF ball formed, the mass density, pressure and temperature in the center became so high that it started the hydrogen fusion, The ice-evap-line generated by the heat of hydrogen fusion quickly expanded to the size of {2,1} and evaporated all ice mass in {1,n=1..5}o super-shell. The evaporated ice mass flew outward. Most of it was captured by {2,2}o orbit and therefore made Jupiter increase its mass by 10×. Small part of it was captures by {2,3}o, and made Saturn increased its mass by 5×, Meanwhile, the {2,1}RF ball switched from {N,n,cold} to {N,n,hot} in size of r-track.

Note: I understand that with the fitting equation's physics meaning is unknown, and with a very rough expected fitting line, this modeled result may have an error in one (or more) order of magnitude. However, this model does lead me to propose a more accurate model in Section VI.

VI. Modeling the original mass of each {N,n} orbit for the whole Solar system, and estimate the mass for {3,n=2..5}o orbit planets/belts.

In Table 3a, r_n and "adjusted to original-ice-Density per shell" of four standard points (Uranus, Neptune, Kuiper belt, and outer Oort) were copied from Table 2. The log-log value is plotted and fitted to a linear regression shown in Figure 4.

Table 3a. Generate the log(D) vs. log(r) plot, and the linear regression line.

	mass	Sun's radius or planets' rn-orbit	gravity-r-track, $r_{n\text{-orbit}} = n^2 r_{1\text{-orbit}}$	adjusted to orginal-ice-Density per shell	log(r)	log(D)
unit	kg	m	m	kg/m^3	log(m)	log(kg/m^3)
Uranus	8.68E+25	2.974E+12	2.85E+12	5.4805E-13	12.46	-12.26
Neptune	1.02E+26	4.506E+12	4.46E+12	2.1716E-13	12.65	-12.66
Kuiper belt	3.00E+25		6.42E+12	3.2992E-14	12.81	-13.48
outer Oort	3.00E+25		5.78E+15	8.991E-24	15.76	-23.05

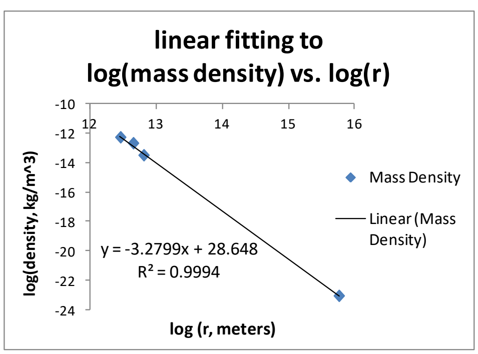

Figure 4. log(D) vs. log(r) plot, and the linear regression.

The fitted equation:

y=-3.279x + 28.64

log(D) = -3.279 log(r) + 28.64

D = 10^(-3.279 log(r) + 28.64) = 10^28.64 * r^(-3.279)

D = 4.37E+28 / r^3.279 (kg/m^3)

So this is the Solar system's mass radial distribution formula in r_n range from {1,2} and beyond. This formula is valid for Solar system only from shell {0,5} and outside (as shown from Table 3b's bottom 4th line "total mass from {0,5} to {4,6}"). It is not valid for the interior of Sun. For the mass density inside the Sun, please check my paper SunQM-3 section I-f.

Now we can calculate the mass in each n shell of Solar system by:

Mass = ∫ D dV = ∭ D r^2 sin(θ) dr dθ dφ = 4π ∫ D r^2 dr = 4π *4.37E+28 *∫ r^2/r^3.28 dr = 5.49E+29 *∫ (1/r^1.28) dr

So using this formula, I calculated out the original mass of each {N,n} orbit shells for the whole Solar system, from {0,5} to {4,6} (see column 10 in Table 3b). Note: from the result of my paper SunQM-3s1 section II-c5, when calculating the total mass in each n shell, I need to integrate from r_n to r_{n+1} for the spherical shell volume calculation. For n shell volume calculation, the inner border is r_n, the outer border $r_{n+1} = r_1$ * [(total-n) + (period-factor)^N]^2. For example, {2,4} 's outer border, r_{n+1} =1.38E+8 * (144 + 6^2)^2 =4.47E+12 m.

Again here I use {N,n, Cold-G} system, because my main purpose is to estimate the (unknown) mass for shells (or orbits) from {3,2} to {3,5} in the pre-Sun {N,n} QM structure. So the Sun surface {0,2} is scaled down by ~79.4%, from r = 6.96E+8 m to r = 5.52E+8 m, and Sun core scaled from r = 1.74E+8 m to r = 1.38E+8 m. In this model, I only need to use Sun core {0,1} 's r (=1.38E+8 m). All planets and theirs orbit-r are not needed. I still keep them there (in Table 3b column 2 & 3) only for comparison.

Table 3b. Use D = 4.37E+28 / r^3.279 to calculate the mass for shells of {3,n=2…6} and {4,n=2…6} for the pre-Sun {N,n} QM structure.

	mass	Sun's body-r, planets' orbit-r	N, Sun{0,1}	n	period factor	total n (base-freq)	gravity-r-track, $r_{n\text{-orbit}} = n^2 r_{1\text{-orbit}}$	$r_{n+1,border} = (n+1)^2 r_{1\text{-orbit}}$	calc Mass per shell	mass ratio to planet	mass ratio to Earth	mass ratio to Jupiter	Mass gain
unit	kg	m					m	m	kg	kg/kg	kg/kg	kg/kg	kg
{0,1} Sun core			0	1	6	1	1.38E+08	5.51E+08					
{0,2} Sun surface			0	2	6	2	5.51E+08	1.24E+09					
			0	3	6	3	1.24E+09	2.20E+09					
			0	4	6	4	2.20E+09	3.44E+09					
			0	5	6	5	3.44E+09	4.95E+09	4.06E+26			0.21	-4.06E+26
			0	6	6	6	4.95E+09	6.74E+09	3.13E+26			0.16	-3.13E+26
{1,2}			1	2	6	12	1.98E+10	4.46E+10	5.22E+26			0.28	-5.22E+26
Mercury	3.3E+23	5.79E+10	1	3	6	18	4.46E+10	7.93E+10	3.04E+26	921.21	50.9	0.16	-3.04E+26
Venus	4.87E+24	1.08E+11	1	4	6	24	7.93E+10	1.24E+11	2.05E+26	42.09	34.3	0.11	-2.00E+26
Earth	5.97E+24	1.49E+11	1	5	6	30	1.24E+11	1.78E+11	1.48E+26	24.79	24.8	0.08	-1.42E+26
Mars	6.42E+23	2.28E+11	1	6	6	36	1.78E+11	2.43E+11	1.16E+26	180.69	19.4	0.06	-1.15E+26
Jupiter	1.9E+27	7.78E+11	2	2	6	72	7.14E+11	1.61E+12	1.92E+26	0.10	32.2	0.10	1.71E+27
Saturn	5.68E+26	1.428E+12	2	3	6	108	1.61E+12	2.85E+12	1.11E+26	0.20	18.6		4.57E+26
Uranus	8.68E+25	2.974E+12	2	4	6	144	2.85E+12	4.46E+12	7.52E+25	**0.87**	12.6		1.16E+25
Neptune	1.02E+26	4.506E+12	2	5	6	180	4.46E+12	6.42E+12	5.46E+25	**0.54**	9.1		4.74E+25
Kuiper	2.99E+25	5.913E+12	2	6	6	216	6.42E+12	8.74E+12	4.21E+25	1.41	7.1		
{3,2}			3	2	6	432	2.57E+13	5.78E+13	7.12E+25		**11.9**		
{3,3}			3	3	6	648	5.78E+13	1.03E+14	3.99E+25		**6.7**		
{3,4}			3	4	6	864	1.03E+14	1.61E+14	2.75E+25		**4.6**		
{3,5}			3	5	6	1080	1.61E+14	2.31E+14	1.98E+25		**3.3**		
{3,6} Inner Oort, start 2000AU			3	6	6	1296	2.31E+14	3.15E+14	1.55E+25		2.6		
{4,2} Inner Oort, start 2000AU			4	2	6	2592	9.25E+14	2.08E+15	2.57E+25		4.3		
{4,3} Inner Oort, end 20000AU			4	3	6	3888	2.08E+15	3.70E+15	1.50E+25		2.5		
{4,4} outer Oort, start 20000AU			4	4	6	5184	3.70E+15	5.78E+15	1.01E+25		1.7		
{4,5} outer Oort,end 50000AU			4	5	6	6480	5.78E+15	8.32E+15	7.34E+24		1.2		
{4,6} outer Oort,end 100000AU			4	6	6	7776	8.32E+15	1.13E+16	8.41E+24		1.4		
Total mass from {0,5} to {4,6}	2.70E+27	kg							2.73E+27	kg			
Total mass from {0,5} to {1,6}	0.0062	Jupiter mass							1.06	Jupiter mass			
Total mass from {2,2} to {2,3}	1.30	Jupiter mass							0.16	Jupiter mass			
Total mass from {2,4} to {2,5}	0.34	Jupiter mass							0.10	Jupiter mass			

Result & discussion (of Table 3b):

1) The model calculated total mass from {0,5} to {4,6} is 2.73E+27 kg (see bottom-up line #4 column 10). It matches the real data (=2.7E+27 kg, column 2). So this equation (D = 4.37E+28 / r^3.279), derived from the < 1% leftover mass in N>1 space, works for the Solar system from {0,5} and beyond.

2) The original mass in space {0,5} through {1,6} was =1.06× of Jupiter mass (see bottom-up line #3 column 10), now is 0.006× of Jupiter mass, Meanwhile the total original mass from {2,2} through {2,3} increased from 0.16× of Jupiter mass (see bottom-up line #2 column 10) to the current 1.30× of Jupiter mass. It clearly shows that the lost mass in N=1 super-shell is captured by {2,2} and {2,3} orbits.

3) The original mass in {2,4} (and outside) orbit shell(s) is basically unchanged (or have limited increase). In summary, this simplified model tells us that > 99% of mass within space of {0,5} collapsed into Sun {0,2}, > 99% of (ice) mass in space of {0,n=5..6} and {1,n=2..6} moved to {2,2}o and {2,3}o orbit shell, and mass in {2,4} through {4,6} is basically unchanged.

4) Between {3,2}o and {3,5}o orbit space, there will be four expected planets/belts, each with about 12×, 7×, 5× and 3× of Earth mass. The result is almost the same as those manually fitted result (20×, 9×, 5×, 4× of Earth's mass) shown in Table 2 (bottom, column 18).

5) The total mass of the inner Oort is estimated to be (2.6 + 4.3 + 2.5) = 9.4 of Earth mass, if the outer Oort is 5× of Earth mass (as the model supposed).

6) It is interesting (and also surprising) to see that the original mass of Mercury, Venus, Earth, and Mars are 51×, 34×, 25×, and 19× of Earth's mass. And at least 96% of them (almost all is hydrogen, some ice) eventually captured by Jupiter and Saturn. It is also interesting to know that orbits of {0,5} to {1,5} had original mass of between 0.28× to 0.08× of Jupiter mass. So Jupiter-size planets could have stayed in any of these orbits if they had found a way to survive under Sun's ice-evap-line temperature. This may give us a chance to explain why some other stars have a much closer Jupiter (see wiki "hot Jupiter").

7) A quantum collapse from {N,1}RF ball to {N-1,1}RF ball is expected to cause a quantum jump up of {N-1,1}RF ball's spin speed.

8) There is a small problem: according to formula D = 4.37E+28 / r^3.279, Uranus' mass should not be smaller than that of Neptune's. To solve this problem, let me propose the following model: After the pre-Sun ball disk-lyzed, before the hydrogen fusion effect, the original {2,2} to {2,5} had original mass 1.92E+26, 1.11E+26, 7.52E+25 and 5.46E+25 kg (obtained from Table 3b). Then after Sun's Hydrogen fusion, orbits of {2,2} to {2,5} gained some extra mass. Now let us ignored {N,n,Cold} to {N,n,Hot} change, and take {2,4} as the outlier. Table 3b column 14 shows {2,2}, {2,3}, and {2,5} orbits gain extra mass of 1.71E+27, 4.57E+26, and 4.74E+25 kg. By using three points to plot log(r_n) vs. log(gained mass), and by assuming the log(gained mass) vs. log(r) has a linear relationship, I obtained the formula for extra gained mass ΔM= 2.34E+51 / r^2.031 (see Table 3c and Figure 4b). Using this formula, I obtained that orbits of {2,2} to {2,5} gained extra mass of 1.65E+27, 4.82E+26, 1.09E+26 and 4.67+25 kg respectively (see column 5 of Table 3d). So the total mass in each orbit from {2,2}o to {2,5}o is: 1.85E+27, 5.93E+26, 1.84E+26, and 1.01E+26 kg (see column 6 of Table 3d). Therefore the original mass of Uranus was larger than that of Neptune's. However, during a catastrophic collision, Uranus changed its spin axis by ~90 degree, ~53% of its total mass was excited to such high orbit level that it was captured by other neighboring planets. As the result of this collision, Uranus lost ~53% of mass (see column 7 of Table 3d). For the rest ~47% mass, its planet surface was excited from p{1,1//2} = p{0,2//2} (using Earth-sized core as p{0,1//2}) to at least p{0,4//2} = p{2,1} (see paper SunQM-3s4). After cool down, Uranus' surface de-excited back to p{0,2//2}, and left many rings at the region of p{0,4//2} and p{0,3//2} as evidence that there was a ball QM structure before the collapse. All rings are the evidence of previous ball QM structure that collapsed! This is a simplified calculation model. For a more accurate result, I need to include the {N,n,Cold} to {N,n,Hot} change, and need to do more iterative calculation.

Table 3c. log(mass gained) vs. log(r) plot, and the linear regression for {2,n=2..5}o.

	orbit rn	mass gained	log(rn)	log(mass gained)
	m	kg		
Jupiter	7.78E+11	1.71E+27	11.89	27.23
Saturn	1.43E+12	4.57E+26	12.15	26.66
Neptune	4.51E+12	4.74E+25	12.65	25.68

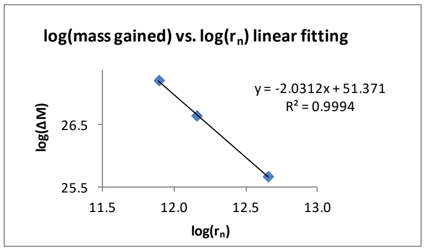

Figure 4b. log(mass gained) vs. log(r) plot, and the linear regression for {2,n=2..5}o.

log(ΔM)=-2.0312 log(r) +51.37
ΔM= 10^(-2.0312 log(r) +51.37) =10^51.37 * r^(-2.031) = 2.34E+51 / r^2.031

Table 3d. Determine the mass loss of Uranus using ΔM= 2.34E+51 / r^2.031.

	$M_{current}$	orbit rn	original mass	mass gained, ΔM= 2.34E+51 / r^2.031	M_{sum} =$M_{original}$ + ΔM	($M_{current}$ - M_{sum})/M_{sum}
	kg	m	kg	kg	kg	kg/kg
Jupiter	1.90E+27	7.78E+11	1.92E+26	1.65E+27	1.85E+27	0.03
Saturn	5.68E+26	1.428E+12	1.11E+26	4.82E+26	5.93E+26	-0.04
Uranus	8.68E+25	2.974E+12	7.52E+25	1.09E+26	1.84E+26	-0.53
Neptune	1.02E+26	4.506E+12	5.46E+25	4.67E+25	1.01E+26	0.01

VII. The formation of Asteroid belt at {1,8}o orbit

So far, Asteroid belt's orbit has not been fitted into the main sequence of the Solar QM {N,n}orbit system. There are several hypotheses for the origin of Asteroid belt (see wiki "Asteroid belt"). Consider the heat of pre-Sun's hydrogen fusion evaporated all icy mass inside the {2,1}RF ball, and caused them flew outward and re-located to {2,2}o and {2,3}o orbits, I believe that Asteroid belt is the residue rocky mass of those gigantic icy fragments, which was left on the way flying to {2,2}o orbit. Since its orbit r is in the r-dimension space between orbit {2,1}o = {1,6}o and {2,2}o = {1,12}o, it is naturally to think the possible orbits of {1,n=7..11}o. In Table 4, the possible orbits of {1,n=7..12}o is constructed, and is tried to match with Asteroid belt's r (as well as Jupiter's r).

Due to orbits {1,n=7..12}o are beyond {1,6}, if its QM is dominated by {1,1}RF, then its period factor =6. Or if its QM is dominated by {2,1}RF, then its period factor =5.33. In the {1,1}RF dominated QM generated {1,n=7..12}o (see columns 6-9 of Table 4), the Asteroid belt's orbit-r (=4.14E+11 meters) fits to the {1,8}o orbit-r (=4.01E+11 m) very well, while Jupiter's orbit-r (=7.8E+11 meters) fits to the {1,11}o orbit-r (=7.58E+11 m) very well. {1,n=7..11}o orbits has a set of orbit-r values= 2.1, 2.7, 3.4, 4.2, 5.1 AU. Surprisingly, they match to the wiki "Asteroid belt" 's data 2.0AU, 2.3-2.7-3.1AU, 3.4AU, 4.0AU, 5.2AU rocky belts very well (see Figure 5)!

On the other hand, in the {2,1}RF dominated QM generated {1,n=7..12}o orbits (see columns 11-13 of Table 4), the Asteroid belt is {1,9}o with r=4E+11 m, and Jupiter is {1,12}o = {2,2}o. But comparing orbit-r of {1,n=7..12} (1.6, 2.1, 2.7, 3.3, 4.0, 4.8 AU) to Figure 5 's data, the 1.6 AU is completely missed, and 4.8AU is shifted (too much) to 5.2AU. So the {2,1}RF dominated QM generated {1,n=7..12}o orbits is abandoned. A second reason is {2,1}RF's QM can only generate {2,n=1..5}o strong orbits and {2,n=7..11}o weak orbits, it is not possible to generate {1,n=7..11}o weak orbits.

Therefore, the Asteroid belt (re-presented by Ceres' orbit) is assigned to be in a {1,8}o orbit, and {1,n=7..11}o orbits are generated by {1,1}RF's QM with period factor = 6.

Table 4. Determine the formation of Asteroid belt at {1,8}o orbit.

					{1,1}RF dominanted QM				{2,1}RF dominanted QM			
	mass	Sun's radius or planets' $r_{n\text{-orbit}}$	N	n	period factor	total n, Sun core=r1	calc. $r_{n\text{-orbit}}$= $n^2\ r_{1\text{-orbit}}$	calc. $r_{n\text{-orbit}}$=	period factor	total n, Sun core=r1	calc. $r_{n\text{-orbit}}$= $n^2\ r_{1\text{-orbit}}$	calc. $r_{n\text{-orbit}}$=
unit	kg	m					m	AU			m	AU
{0,1}			0	1	6	1	1.74E+08		6	1	1.74E+08	
{1,2}			1	2	6	12	2.50E+10		6	12	2.50E+10	
Mercury	3.3E+23	5.79E+10	1	3	6	18	5.64E+10		6	18	5.64E+10	
Venus	4.87E+24	1.08E+11	1	4	6	24	1.00E+11		6	24	1.00E+11	
Earth	5.97E+24	1.49E+11	1	5	6	30	1.57E+11	1.05	6	30	1.57E+11	1.05
Mars	6.42E+23	2.28E+11	1	6	6	36	2.25E+11	1.51	6	36	2.25E+11	1.51
			1	7	6	42	3.07E+11	2.06	5.33	37.3	2.42E+11	1.62
Ceres_Asteroid belt	3.21E+21	4.14E+11	1	8	6	48	4.01E+11	2.69	5.33	42.6	3.16E+11	2.12
			1	9	6	54	5.07E+11	3.40	5.33	48.0	4.00E+11	2.69
			1	10	6	60	6.26E+11	4.20	5.33	53.3	4.94E+11	3.32
{2,2} Jupiter	1.898E+27	7.78E+11	1	11	6	66	7.58E+11	5.08	5.33	58.6	5.98E+11	4.01
			1	12	6	72	9.02E+11	6.05	5.33	64.0	7.12E+11	4.78

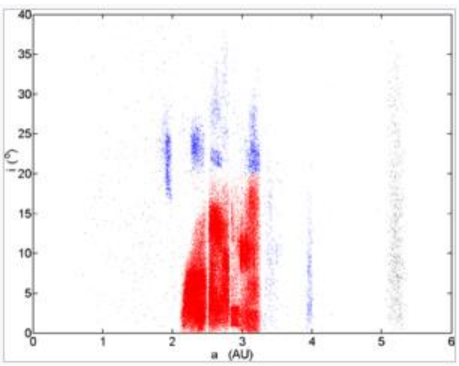

Figure 5. *The Asteroid belt showing the orbital inclinations versus distances from the Sun, with asteroids in the core region of the asteroid belt in red and other asteroids in blue*. Copied from wiki "Asteroid belt" [3].

Table 5. Estimate the mass of {1,n=7..11} planet/belt.

					{1,1}RF dominanted QM											
	mass	Sun's radius or planets' $r_{n\text{-orbit}}$	N	n	period factor	total n, Sun core=r1	calc. $r_{n\text{-orbit}}$= $n^2\ r_{1\text{-orbit}}$	calc. $r_{n\text{-orbit}}$=	inner border- r_n=avg(r_n, r_{n-1})	outer border- r_n=avg(r_n, r_{n+1})	Density=	log(r)	log(D)	back calc. D=5.1286E+121 /r^(11.68)	calc Mass per shell	Mass ratio to Mars' mass
unit	kg	m					m	AU	m	m	kg/m^3	log(m)	log(kg/ m^3)	kg/m^3	kg	kg/kg
{0,1}			0	1	6	1	1.74E+08									
{1,2}			1	2	6	12	2.50E+10									
Mercury	3.3E+23	5.79E+10	1	3	6	18	5.64E+10									
Venus	4.87E+24	1.08E+11	1	4	6	24	1.00E+11		7.83E+10	1.28E+11	7.11E-10	11.00	-9.15			
Earth	5.97E+24	1.49E+11	1	5	6	30	1.57E+11	1.1	1.28E+11	1.91E+11	2.94E-10	11.19	-9.53			
Mars	6.42E+23	2.28E+11	1	6	6	36	2.25E+11	1.5	1.91E+11	2.66E+11	1.29E-11	11.35	-10.89	1.28E-11	6.37E+23	0.9924
			1	7	6	42	3.07E+11	2.1	2.66E+11	3.54E+11				3.50E-13	3.72E+22	0.0580
Ceres_Asteroid belt	3.21E+21	4.14E+11	1	8	6	48	4.01E+11	2.7	3.54E+11	4.54E+11	1.56E-14	11.60	-13.81	1.54E-14	3.19E+21	0.0050
			1	9	6	54	5.07E+11	3.4	4.54E+11	5.67E+11				9.86E-16	3.65E+20	0.0006
			1	10	6	60	6.26E+11	4.2	5.67E+11	6.92E+11				8.41E-17	5.26E+19	0.0001
{2,2} Jupiter	1.9E+27	7.78E+11	1	11	6	66	7.58E+11	5.1	6.92E+11							

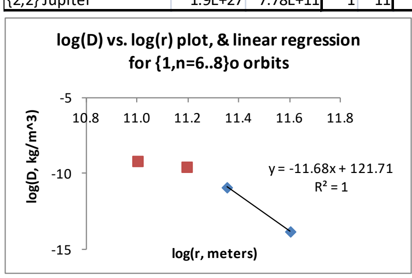

Figure 6. log(mass density) vs. log(r) plot, and the linear regression for {1,n=6..8}o orbits.

Then I try to estimate the mass for each of {1,n=7..11} orbits. In section VI, I assumed the (ice) mass distribution along r of orbits from {2,2}o to {4,6}o has the log-log linear relationship, then I obtained (ice) mass for each orbit, Here again I assuming this rocky mass distribution along r of orbits {1,n=6..11}o has the similar log-log linear relationship. In table 5 and Figure 6, by using mass of {1,6}o Mars, and {1,9}o Asteroid belt to obtain the mass densities, then doing the log-log linear regression, I obtained the fitting curve log(D) = -11.68 log(r) + 121.71. Note: Earth and Venus were not included due to they formed in a completely different QM process.
D = r^(-11.68) * 10^(121.71)
So the relation between rocky mass density and orbit-r from orbit range (1,6} to {1,11} is modeled as
D = 5.1286E+121 / r^(11.68)

Column 17 of Table 5 shows that according to this model, total mass (of planet or belt) at each orbit from {1,7} to {1,10} are 5.8%, 0.5%, 0.06%, and 0.01% of that of Mars mass.

The next question is, if this model is correct, then where are these {1,7}, {1,9}, {1,10}, {1,11} planet/belt ? The current physics already give answer to this question: the orbital resonance with Jupiter can either stabilize or destabilize objects moving in some orbits. Wiki "Asteroid belt" listed some orbits which are destabilized by Jupiter through resonance: 4:1 resonance at 2.06 AU, 3:1 resonance at 2.5 AU, 5:2 resonance at 2.82 AU, 2:1 resonance at 3.28 AU.

According to wiki "orbital resonance", "*orbital resonance occurs ... because their orbital periods are related by a ratio of two small integers*", I try to search possible resonance effect of Jupiter on {1,n=7..11} orbits, but purely based on the {N,n} QM orbit system, not based on the true orbits of those Asteroid objects.

The relation of $r_n = r_1 *n^2$ produces relation of $n*v_n = v_1 =(n-k)\ v_{n-k}$, or $v_{n-k} = v_n\ n/(n-k)$, where k is a small integer number k=1, 2, 3, 4, so that if n=11, then (n-k) = 10, 9, 8, 7. Since Jupiter is in orbit {1,11}o, define its orbit $v = v_{Jupiter}$, then orbit {1,n=7..11}o 's $v_n = v_{Jupiter} *11/n$. Each orbit's period T_n can be calculated as $v_n\ T_n = 2\pi\ r_n$, or $T_n = 2\pi\ r_n / v_n$. Or $T_n / T_{n-k} = (2\pi\ r_n / v_n) / (2\pi\ r_{n-k} / v_{n-k}) = (r_n / r_{n-k}) *(v_{n-k} / v_n)$, = (r_1 * n^2) / (r_1 * (n-k)^2) * (v_1 /(n-k)) / (v_1 / n) = [n/(n-k)]^2 * (n/(n-k)) = [n/(n-k)]^3. So in a perfect {1,n=7..11}o orbit system, the {1,11} Jupiter will resonance with {1,(n-k)} orbit by (11/(n-k))^3 ratio, e.g., (11/7)^3= 1331/343, although this is not a small integer ratio. Then let us define two small integer i=1..8, j=1..8, and we need $i*T_{n=11} / (j*T_{n-k})$ = i/j *[(n=11)/(n-k)]^3 ≈1 according to the definition of the orbital resonance. A search table was constructed as shown in Table 6. The searched results between 0.90 and 1.10 are marked with yellow color.

The result shows that {1,7} has a strong 4:1 resonance with {1,11} Jupiter, {1,8} has a strong 5:2 and 8:3 resonance with {1,11} Jupiter, and {1,9} has a strong 2:1 resonance with {1,11} Jupiter, There are also some other (relative weak) resonances (5:3 and 7:4 for {1,9}, 4:3, 5:4, 7:5 for {1,10}). However, why resonances stabilize some orbits but destabilize some other orbits is beyond my knowledge. Whatever the reason is, data in Figure 5 does suggest the existence of orbits {1,n=7..11}o.

Table 6. A search of i=1..8, j=1..8 for orbital resonance of {1,n=7..10}o with Jupiter {1,11}o.

	(n-k)=	7	8	9	10	11
	[11/(n-k)]^3	3.880	2.600	1.826	1.331	1
i=	j=	i/j*[11/(n-k)]^3	i/j*[11/(n-k)]^3	i/j*[11/(n-k)]^3	i/j*[11/(n-k)]^3	i/j*[11/(n-k)]^3
1	1	3.88	2.60	1.83	1.33	1.00
1	2	1.94	1.30	0.91	0.67	0.50
1	3	1.29	0.87	0.61	0.44	0.33
1	4	0.97	0.65	0.46	0.33	0.25
1	5	0.78	0.52	0.37	0.27	0.20
...	...	...	...	...	...	...
2	4	1.94	1.30	0.91	0.67	0.50
2	5	1.55	1.04	0.73	0.53	0.40
2	6	1.29	0.87	0.61	0.44	0.33
2	7	1.11	0.74	0.52	0.38	0.29
2	8	0.97	0.65	0.46	0.33	0.25
3	1	11.64	7.80	5.48	3.99	3.00
3	2	5.82	3.90	2.74	2.00	1.50
3	3	3.88	2.60	1.83	1.33	1.00
3	4	2.91	1.95	1.37	1.00	0.75
3	5	2.33	1.56	1.10	0.80	0.60
3	6	1.94	1.30	0.91	0.67	0.50
3	7	1.66	1.11	0.78	0.57	0.43
3	8	1.46	0.97	0.68	0.50	0.38
...	...	...	...	...	...	...
4	5	3.10	2.08	1.46	1.06	0.80
4	6	2.59	1.73	1.22	0.89	0.67
4	7	2.22	1.49	1.04	0.76	0.57
4	8	1.94	1.30	0.91	0.67	0.50
...	...	...	...	...	...	...
8	7	4.43	2.97	2.09	1.52	1.14
8	8	3.88	2.60	1.83	1.33	1.00

With all results from sections I to VII, now I am able to re-constructed a complete story of how Asteroid belt was formed based on the Solar QM {N,n} structure model. Let us continue from section V result & discussion-5. Immediately after {3,1}RF pre-Sun ball collapsed into {2,1}RF pre-Sun ball (={1,6} in size), the mass in orbit space of {1,n=7..11}o was cleared out by the "ball-torus-gap" effect even the {1,n=7..11}o orbits were not exist yet. At {2,1}RF, the hydrogen fusion started and generated ice-evap-line and expanded to near {2,1}. The ice mass in {1,n=1..5}o super-shell started to evaporate and flew outward. At this stage, the peak of ice mass distribution in r-dimension was probably at {1,6}o orbit. As {2,1}RF ball further collapsed to {1,1}RF ball, a set of new (weak) orbits of {1,n=6..11}o are now available (under the {1,1}RF QM), the out-flying ice mass can stop at any of these new orbits (depend on its r-dimension kinetic energy). As {1,1}RF ball finally collapsed to {0,1}RF ball, the hydrogen fusion ball expanded to the current size of {0,1}, and the ice-evap-line expanded to current {1,9} to {1,10}, all ice mass within {1,10} was evaporated, out-flown, and captured by {1,11}o={1,12}o={2,2}o and {2,3}o orbit, only some rocky residues were left on orbit {1,n=7..10}o as belts. This was done in a way that each ice fragment (big or small), like the icy comet, was a mixture containing small part of rock fragments. For small and medium sized ice fragments, while all ice part completely evaporated, and water molecule mostly flew outward and captured by {2,2}o orbit, the residue rocky part was left in {1,n=7..10}o orbit. For a gigantic ice fragment, the Sun-facing part was evaporated by Sun's heat, generated steam jet and provided force to push main body of ice fragment flying outward, and then captured by {2,2}o. The steam jet part also contained rocky residues, and they were left in {1,n=7..10}o orbits, forming belt/planet just like the Asteroid belt and Ceres. At the end of this stage, the peak of ice mass distribution in r-dimension should be at {1,11}o. Then Jupiter at {1,11}o somehow destabilized and ejected the residue rocky mass in (low inclination) orbits of {1,7}o, {1,9}o, and {1,10}o through orbital resonance. Only rocky mass in orbit {1,8}o was stabilized by Jupiter and it is the one that we call Asteroid belt today. Luckily, all the high inclination orbits seems are not significantly affected by orbital resonance, so that the concentrated high inclination asteroids at 2.0AU, 2.3-2.7-3.1AU, 3.4AU, 4.0AU, 5.2AU become the evidence that orbits {1,n=7..11} do exist (see Figure 5)!

In QM terminology, Sun provided heat energy to excite the ice fragments in {2,1}o ground state orbit and made them jumped to the {2,2}o excited state orbit. For the residue rock fragments in the steam jet, the Sun heat energy excited them from low energy orbit (1,6}o to higher energy orbits {1, n=7..10}o.

VIII. Besides {1,n=7..11}o, looking for other possible {N,n=7..11}o orbits

In general, after pre-Sun {N+1,1}RF ball quantum collapsed into {N,1}RF ball, the mass in {N,n=2..6} super-shell space quickly disk-lyzed into torus shape, so the mass linkage between the newly formed {N,1}RF ball and {N,n=2..6} torus is completely cut off (see Figure 2). In other word, the mass in between {N,1} and {N,2} should be cleared (by the quantum collapse dynamics of {N,n} QM). this is because {N-1,6}o orbit covers shell space from {N-1,6} to {N-1,7}, while {N,1}o orbit covers shell space from {N,1}={N-1,6} to {N,2}={N-1,12}.

After {N,1}RF ball further collapsed to {N-1,1}RF ball, governed by the QM of {N-1,1}RF, a new set of {N-1, n=7..11}o weak orbits are available. This is why in the Solar QM {N,n//6} structure Periodic Table (see paper SunQM-1) I added n=7..11 weak orbits besides the n=1..5 strong orbits. During {N,1}RF to {N-1,1}RF quantum collapse (or any {N,1}RF collapse), besides > 99% mass in {N-1,n=2..6} super-shell collapsed into {N-1,1}RF ball, and < 1% mass leftover in {N-1,n=2..6} super-shell and then disk-lyzed, I can image that << 0.1% of mass (with angular momentum |L| at the high-end of Boltzmann distribution) will be ejected outward, it is just like when Sun collapse to white dwarf, part of its surface mass will explore outward. Those mass fragments with very high $|L_z|$ will be eject out in x-y plane, and will transition to {N-1,n=7..11}o orbits. Those mass fragments with very high $|L_{xy}|$ will be eject out in z-direction as a burst of bipolar outflow, and will then fall back to {N-1,1}RF ball. The dynamics determines that the objects in {N,n=7..1}o orbits must be very small. For N=2, 3, 4, 5 super-shells, {N,n=7..11}o small objects are unable to be seen if they are in circular orbits (simply due to they are too far away than {1,n=7..11}o). Only those highly eccentric orbited {N,n=7..11}o small objects could be seen by chance (e.g., scattered disc, see wiki "Scattered disc", see paper SunQM-1 "Solar QM {N,n//6} structure Periodic Table"). For N =0, orbits {0,n=7…11}o were within the rock-evap-line (see section X for detail), so they must be empty orbits. So the only observable small objects of {N,n=7..11}o is in {1,n=7..10}o orbits.

IX. Each quantum collapse of {N,1}RF structure to {N-1,1}RF structure is expected to be accompanied by

1) "Ball-torus-7-11-gap effect", the mass in {N-2,n=7..11}o orbit space is clear out.
2) A quantum jump up of angular momentum for the newly formed {N-1,1}RF ball (driven by the angular momentum conservation).
3) {N-1,n=2..6} super-shell disk-lyzation (driven by nLL QM effect, see paper SunQM-3s1).
4) A burst of bipolar outflow (driven by nL0 effect, see paper SunQM-3s1, and SunQM-3s5).
5) A new set of weak orbits {N-1,n=7..11}o available.

X. Mass QM {N,n} structure collapse vs. heat QM {N,n} structure expansion in the Solar QM {N,n} structure dynamics.

The dynamics of Solar QM {N,n} structure has led me discovered a series of quantum collapse processes from {5,1} down to {0,1}, then to {-3,1} or even lower. Meanwhile, a series of quantum expansion of {N,n} QM structures caused by the nuclear fusion also emerges in parallel to the quantum (mass distribution) collapse. For example, the ice-evap-line must have expanded from small size to today's {1,9}, and the rock-evap-line must also have expanded from small size to today's {1,2}. This led me to realize that for the gravity-r-track, it is the quantum collapse of mass distribution. For heated-r-track, it is quantum expansion of heat distribution!

A hypothesized dynamics model of the heated {N,n} structural expansion, using the gravity collapse of {N,1} structure as the timeline (in column 1), is constructed in Table 7a and 7b. Table 7a shows an over-simplified dynamics of the heated {N,n} structure expansion vs. pre-Sun collapse timeline. It gives a straight forward dynamic driving force between hydrogen fusion {N,n} expansion and pre-Sun {N,1}RF collapse, but difficult for many explanations in sections V, VI, VII.

Table 7a. An over-simplified version of a hypothesized dynamics of the heated {N,n} structure expansion, using pre-Sun {N,1} collapse as the timeline (in column 1, downward).

	Heated line expansion, size in {N,n}												
	{-7,1}	{-6,1}	{-5,1}	{-4,1}	{-3,1}	{-2,1}	{-1,1}	{0,1} current	{1,1}	{2,1}	{3,1}	{4,1}	{5,1}
TIMELINE that followed {N,1} pre-Sun collapse													
{5,1}			H-fus	rock-evap	ice-evap								
{4,1}			He-fus	H-fus	rock-evap	ice-evap							
{3,1}				He-fus	H-fus	rock-evap	ice-evap						
{2,1}					He-fus	H-fus	rock-evap	ice-evap					
{1,1}						He-fus	H-fus	rock-evap	ice-evap				
{0,1} current							He-fus	H-fus	rock-evap	ice-evap			
{-1,1}								He-fus	H-fus	rock-evap	ice-evap		

Reading example:

As pre-Sun {N,1} collapsed from {5,1} to {4,1}, {3,1}, {2,1} (see 1st column in Table 7a), its hydrogen fusion grew from {-5,1} to {-4,1}, {-3,1}, {-2,1} in size. At current time when Sun {N,n} collapsed to {0,1}, its hydrogen fusion grows to {0,1} size, rock-evap-line grows to {1,1}, ice-evap-line grows to {2,1}, He-fusion-line grows to {-1,1}.

So according to Table 7a, what I mentioned before "The collapse of {3,1} and formation of {2,1} ignited the Sun's hydrogen fusion" was not accurate. A more accurate statement should be "The pre-Sun collapsed to {2,1} caused its hydrogen fusion ball grew to {-2,1} and ice-evap-line grew to {0,1}, which started to significantly affect the ice mass distribution in the space between {0,1} and {2,1}". But it is difficult to image that how a ice-evap-line at {0,1} is able to affect the ice mass distribution beyond {0,1}, or even beyond {1,1}. So, even this model is simple and straight forward, it has difficult for many explanations in sections V, VI, VII. Therefore I discarded the dynamic model in Table 7a.

Table 7b shows a modified dynamics of the heated {N,n} structure expansion vs. pre-Sun collapse timeline. The timeline has been modified according to explanations in sections V, VI, VII. It re-explains the current astronomical physics in the frame of Solar QM {N,n} structure.

Table 7b. A better version of a hypothesized dynamics of the heated {N,n} structure expansion, using pre-Sun {N,1}RF collapse as the timeline (in column 1, downward).

	SIZE of the heat-ball expansion in {N,n}													
	{-7,1}	{-6,1}	{-5,1}	{-4,1}	{-3,1}	{-2,1}	{-1,1}	***{0,1} current***	{1,1}	{2,1}	{3,1}	{4,1}	{5,1}	{6,1}
TIMELINE that followed {N,1} pre-Sun collapse														
{5,1}														
{4,1}														
{3,1}														
{2,1}														
	H-fus	rock-evap	ice-evap											
		H-fus	rock-evap	ice-evap										
			H-fus	rock-evap	ice-evap									
				H-fus	rock-evap	ice-evap								
					H-fus	rock-evap	ice-evap							
						H-fus	rock-evap	ice-evap						
							H-fus	rock-evap	ice-evap					
								H-fus	rock-evap	ice-evap				
{1,1}								H-fus	rock-evap	ice-evap				
{0,1} current							***He-fus***	***H-fus***	***rock-evap***	***ice-evap***				
Red Giant							C	He-fus	H-fus	rock-evap	ice-evap			
explosion							C	He-fus			rock-evap	ice-evap		
explosion							C					rock-evap	ice-evap	ice-evap
{-1,1}							C							
Table 7b2. For larger mass Stars, **single explosion model** (at only neutron star, no explosion at end of red dwarf).														
{0,1}		Og fus	Au fus	Ag fus	Fe fus	Mg,Si,S fus	C,O,Ne fus	H,He fus	rock-evap	ice-evap				
{-1,1}		Og fus	Au fus	Ag fus	Fe fus	Mg,Si,S fus	C,O,Ne fus		rock-evap	ice-evap				
{-2,1}		Og fus	Au fus	Ag fus	Fe fus	Mg,Si,S fus			rock-evap	ice-evap				
			Og fus	Au fus	Ag fus	Fe fus			rock-evap	ice-evap				
				Og fus	Au fus	Ag fus			rock-evap	ice-evap				
					Og fus	Au fus			rock-evap	ice-evap				
		...	Z2.6E+28 fus	Z5E+20 fus	Z1.2E+13 fus	Og fus			rock-evap	ice-evap				
{-3,2} nuetron star		...	Z2.6E+28 fus	Z5E+20 fus	Z1.2E+13 fus				rock-evap	ice-evap				
explosion		...	Z2.6E+28 fus	Z5E+20 fus	Z1.2E+13 fus					rock-evap	ice-evap			
explosion		...	Z2.6E+28 fus	Z5E+20 fus	Z1.2E+13 fus						rock-evap	ice-evap		
explosion		...	Z2.6E+28 fus	Z5E+20 fus	Z1.2E+13 fus							rock-evap	ice-evap	
explosion		...	Z2.6E+28 fus	Z5E+20 fus	Z1.2E+13 fus								rock-evap	ice-evap
{-3,1} black hole		...	Z2.6E+28 fus	Z5E+20 fus	Z1.2E+13 fus									
{-4,1}	...	Z1.3E+36 fus	Z2.6E+28 fus	Z5E+20 fus										
		...	Z1.3E+36 fus	Z2.6E+28 fus										
			...	Z1.3E+36 fus										
				... , quark fus										
{-5,1}			whole star fussed into a single super atom (virtual Z# =4.8E+56), and the virtual atom = single quark size											

Note-1: in Table 7b, H, He fusions belong to the chemical element period-1 fusion. C, O, Ne fusions belong to the chemical element period-2 fusion. Mg, Si, S fusions belong to the chemical element period-3 fusion. Fe-fusion represents the chemical element period-4 fusion. Ag-fusion represents the chemical element period-5 fusion. Au, Pb fusions represent the chemical element period-6 fusion. Og-fusion represents the chemical element period-7 fusion. **Grayed cells** in Table 7b are the size of **collapsed mass structure** in {N,n} (based on the top row) at the time (of the 1st column, also in {N,n}), so they are at the diagonal cells of the table.
Note-2: the bottom half of Table 7b (named table 7b2) "for larger mass stars" is according to the result obtained from paper SunQM-5s1 Table 2.

Result and discussion (for Table 7b):

When pre-Sun nebula quantum collapsed to {5,1}, {4,1}, {3,1} there was no hydrogen fusion in the pre-Sun core, and no ice-evap-line or rock-evep-line. The collapse of pre-Sun from {3,1} structure and formation of {2,1}structure ignited the pre-Sun's Hydrogen fusion. The early hydrogen fusion in the pre-Sun core probably had size much smaller than {-7,1} in millimeters, and sporadically here and there in the pre-Sun core (quantum fluctuation). With continues mass condensation (driven by G-force), and pressure/temperature building up, the mm-size sporadically Hydrogen fusion gradually grew its size to (-5,1} meter-size, and it became a stable hydrogen fusion ball at the center of pre-Sun core. Meanwhile, the heat of a stable {-5,1} hydrogen fusion ball generated a rock-evaporation-line at (probably) $\Delta N = +1$ QM structure within which all rocky material was melted and evaporated, and the evaporated rocky molecule were fly outward from the center of pre-Sun to higher N orbits. The same Heat of hydrogen fusion ball also generated a ice-evaporation-line (or ice-evap-line) at probably $\Delta N = +2$ QM structure, and beyond this r_n (probably start from {N,2}) ice is stable, But r_n at ≤ this line, all icy material is melted and evaporated, and the evaporated icy molecule will fly outward to even higher N orbits. If this is correct, then for a {-5,1} hydrogen fusion ball, the rock-evap-line was at {-4,1}, and the ice-line was at {-3,1}.

Since current Sun contains nearly 99.9% of the total mass of Solar system, so in each {N+1,1}RF collapse, > 99% of mass falls into the {N,1}RF ball, and only < 1% mass left over in space {N,n=2..6}. This should be valid for all matters (hydrogen gas, ice, and rock). So when pre-Sun was just collapsed to {2,1}RF ball, it was in the gravity-r-track with r = 1.78E+11 meters, and {2,1}RF ball contained > 99% of ice mass of the whole solar system. In the ice-mass density vs. r plot, the ice density peak was within {2,1}, probably peaked at {1,6}.

As the pre-Sun's hydrogen fusion ball increased to {-4,1}, {-3,1}, {-2,1}, {-1,1}, then to current {0,1} (should it be quantum increase?), both rock-evap-line and ice-evap-line also increased correspondingly to the current {1,1} and {2,1}. Then all hydrogen & ice in {1,6} shell space (~2E+27 kg, or ~ 0.1% of Sun's total mass as shown in Table 2) was evaporated, with ~78% was captured by {2,2}o orbit and then became part of Jupiter, ~22% captured by {2,3}o orbit and became part of Saturn. Meanwhile, {2,1} transformed to the heated-r-track by increasing r by 26% from 1.78E+11 meters to 2.25E+11 meters (as shown in Table 1).

As that will be explained in my paper SunQM-3, SunQM-3s1, and SunQM-3s2, a {0,1} sized hydrogen fusion ball provides the exact thermal pressure for a {0,1} sized Sun ball, to prevent it from collapse under G-force. So this is a super stable Solar {N,n} QM structure, it will last for 10 billion years.

After this stage, the hydrogen fusion ball will continues expand to {1,1} to be a Red giant, with a He-fusion ball at {0,1}, and rock-evap-line at {2,1}, and ice-evap-line at {3,1}. Then explosion comes which will send the rock/ice evap-lines to much high N space, and extinguish the hydrogen fusion and He-fusion. The rock/ice evap-lines disappeared as they cooled down. This will collapse (or implode) the {0,1}RF QM structure into a {-1,1}RF QM structure (as a white dwarf). Since there will be no nuclear fusion, the heated-r-track will gradually go back to gravity-r-track by decreasing its radius by ~ 20%, after the white dwarf cooled down.

If the mass of the star is between 10× to 29× of our Sun-mass, the astronomical physics tells us that the white dwarf will continue to collapse (see wiki “neutron star”). Under the {N,n} QM theory (see Table 7b2), the carbon fusion ignited long before the Red giant explosion, so its QM {N,n} structure collapse/expansion life will continue. At {-1,1} stage, the most outer layer is the C-fusion shell (due to C is the most light atom among other atoms like O, Ne, Mg, Si, S, etc.), inside followed by the O-fusion layer, and even inside Ne-, Mg-, Si-, S-, Fe, … fusion layers. Once all carbon atoms are fused into heaver atoms (which will be pushed inward afterward), the O-fusion layer will be pushed out to be the most out layer in {-1,1}RF QM structure (due to now O atom is the most light atom). It is equivalent to that O-fusion shell is expanded. Then, after O-fusion run out, Ne fusion layer become the most out fusion layer. During this time, the {-1,1}={-2,6} QM structure decreases its size to {-2,5}, {-2,4}, … due to the light atoms fused into heavier atoms and increases the mass density. After all Ne atoms are fused, the {-1,1} QM structure collapse to {-2,1} QM structure, and now the Mg-fusion layer become the most out layer of {-2,1} QM structure. After all period 3 elements (represented by Mg, Si, S) atoms are fused, then the period 4 elements (represented by Fe) fusion become the most out layer of the {-2,1} QM structure. Then the period 5 elements (represented by Ag) fusion, the period 6 elements (represented by Au) fusion, the period 7 elements (represented by Og) fusion, become the most out layer of the {-2,1} QM structure. This is also equivalent to that period-4 , -5, -6, -7 element fusion shells expands in size one by one. Again, during this time, the {-2,1}={-3,6} QM structure decreases its size to {-3,5}, {-3,4}, … , due to the atoms fused into heavier atoms and further increases the mass density. When all Og atoms are fused, the {-2,1} QM structure collapse to {-3,2} neutron star, and its rock/ice-evap-line explores as the super Nova. According to my study result in paper SunQM-5s1, the neutron star is made of (virtual) atoms with virtual Z = 5E+11 (or even larger).

If the mass of the star is beyond 30× of our Sun, the astronomical physics tells us that the neutron star will further collapse to black hole. During this time, the virtual atoms of Z = 5E+11 will further fuss to become even higher Z number (virtual) atoms. For example, my paper SunQM-5s1 calculated that at black hole {-3,1} QM structure, the averaged virtual atom has Z ≥ 1.2E+13, at black hole {-4,1} QM structure, the averaged virtual atom has Z ≥ 5.0E+20, at black hole {-5,1} QM structure, the averaged virtual atom has Z ≥ 2.6E+28, until all nucleons in a Sun-massed celestial body fussed into a single gigantic nucleus of a single atom (with no electron). For detailed description, please see my paper SunQM-5s1. In paper SunQM-5s1, I also presented a "shrink atom" model to explain the collapse of Sun-liked {0,1} QM structure to {-5,1} size, and it is equivalent to the fusion of H, He, C, O, Ne, Mg, Si, S, Fe.

In Table 7b2, the model of H, He, C, O, Ne, Mg, Si, S, Fe fusion shells comes from YouTube "documentaries 2016 National Geographic Latest Discovery of Universe Documentary Film", "https://www.youtube.com/watch?v=FoFuWBDG624" at time (23:17/44:05). I only tried to assign the possible timeline according to the sequence of {N,n} collapse. It is pure my guess that the size of He-fusion ball is ΔN = -1 to that of hydrogen fusion ball, and this value is not very important in this model. The important thing is that there is a He-fusion ball inside hydrogen fusion ball, and then a C-fusion ball inside He-fusion ball. And not only all these fusion balls have structures governed by QM {N,n} structure, but also the evolution of all these balls follow the QM {N,n} dynamics!

Same as the static Solar QM {N,n} model, the dynamic Solar QM {N,n} model also predicted the sub-stable QM structure at size of {-1,1}, {-2,1} and {-4,1} (besides {-3,2} and {-3,1}), and a super stable {-5,1}RF QM structure at size around r = 3 meters.

Finally, let us look some more examples of expanded (or exploded) super large {N,n} structures:

1) Crab Nebula has a r = 5.5 light years (from wiki "Crab Nebula"), corresponding to N = 5 (r = 1.1 lys), or {N,n} ≈ {5,2} at r = 4.4 lys. So in Table 7b2, it corresponds to the last line of {-3,1} neutron star at the "explosion" stage. It is interesting to know that a neutron star's explosion surface can be Δn = +1 larger than the outer Oort cloud {5,1}, and reach the same distance from Sun to its closest star Alpha Centauri.
2) The first observation of gravitational waves (in 2015, see wiki "First observation of gravitational waves") was originated from a binary black hole merge at distance ~ 440 Mpc = 1.36E+25 meters away, In {N,n} QM structure, this gravitational wave has expanded to around {10,4} in size.
3) If treat the light emitted from a star (the electromagnetic 3D spherical wave front) as a (series of single) EM explosion in {N,n}, then the light from the oldest galaxies (or our observable universe with r = 4.4E+26 meters, from wiki "observable universe") has {N,n} ≈ {11,5}.

This study leads me to further explore the even larger (and smaller) world by using the Solar QM {N,n//6} structure analysis (see paper SunQM-1s2).

XI. Does {-2,1} QM structure (kinetically) stable enough to be observed astronomically as a celestial body?

The {N,n} QM dynamics tells us that a {-2,1} celestial body must exist during a star collapse into a neutron star (or black hole). But it does not tell us whether this {-2,1} stage is kinetically stable enough to be observed astronomically. For the nuclear fusion kinetics of a Sun-massed celestial body,

1) at {0,1} stage, I guess that between hydrogen fusion and He-fusion, hydrogen fusion is the rate-limiting step, so the relative slow hydrogen fusion keeps {0,1} as a super stable QM structure (for 10 billion years for our Sun). Note: Although if under the same condition, He-fusion is more difficult than H-fusion. But inside Sun, we are comparing He-fusion (at center of Sun) with H-fusion (not at center of Sun) at different conditions.
2) At {-1,1} white dwarf stage, due to lacking of enough (G-force generated) thermal pressure, the C-fusion is stopped. So the rate constant of C-fusion nuclear reaction is zero.
3) At {-1,1} (non-white dwarf) stage, among C-, O-, Ne-fusions, I guess C-fusion is the rate limiting step. So the relative slow C-fusion keeps {-1,1} as a stable (or sub-stable) QM structure.
4) At {-2,1} stage, among Mg-, Si, S-, Fe-, Ag-, Au-, Og-fusions, I guess Mg-fusion is the rate limiting step. So the relative slow Mg-fusion keeps {-2,1} as a stable (or sub-stable) QM structure.
5) A neutron star at {-3,2} stage, there is no particular rate limiting step (or stabilization force from the {N,n} QM structure point of view). From wiki "Neutron star", "*Neutron stars are supported against further collapse by neutron degeneracy pressure*". This should be right, but at what {N,n} level? (See paper SunQM-5s1 for more discussion).

The astronomic observation of a neutron star is through the indirect observation (i.e., pulsars, X-ray pulsar binary systems). As wiki "Pulsars" explained; "*A pulsar is a highly magnetized rotating neutron star or white dwarf that emits a beam of electromagnetic radiation*". This raises a question: is it possible that some of the observed pulsars are actually {-2,1} QM structures? I believe that one day with improved (Hubble-like) Space Telescope, we can directly see the size of some nearby neutron stars (that emit only thermal radiation) are actually {-2,1} QM structures that have size of r = 1E+5 meters!

XII. The possible physics meaning of each {N,1} structure in Solar {N,n} QM

From wiki "Sun", "*Sun's surrounding atmosphere ... is composed of four distinct parts: the chromosphere, the transition region, the corona and the heliosphere*". Chromosphere extends from 5E+5 to 2.5E+6 meters above Sun' surface, the transition region from 2.5E+6 to 2.7 E+6 meters, the corona from 2.7E+6 meters above Sun surface to 0.1 AU from Sun, and the heliosphere from 0.1 AU to 50 AU from Sun. In Solar QM {N,n} system, the corona perfectly matches to n=3, 4, 5, and 6 shells of Sun's {1, n=2..6} QM structure (see paper SunQM-1 Table 3). Also the heliosphere perfectly matches to Solar QM's {1, n=2..6} and {2,n=2..6} super-shell structure (see paper SunQM-1 Table 3).

So it seems that Sun's {0,1} structure is the ground state of hydrogen fusion ball, {1,1} structure is the ground state of corona radiation ball (and the rock-evap-line ball), {2,1} structure is the ground state of ice-evap ball, {3,1} structure is the ground state of heliosphere radiation (solar bubble, solar wind) ball, {4,1} structure is the ground state of unknown character ball, {5,1} structure is the ground state of effective (or strong, or bound-state) G-force field ball. {6,1} structure is the ground state of ineffective (or weak, or unbound-state) G-force field ball.

Conclusion

1) Solar system was formed by a series of quantum collapse of pre-Sun nebula from {6,1} to {5,1}, {4,1}, …down to {0,1}, and it will continue to collapse to {-1,1}, the white dwarf.
2) At the {2,1} stage, the Solar {N,n} system had shifted from gravity-r track to the heated-r track (by increasing r to 26% larger) due to the hydrogen fusion. It will shift back to gravity-r track after the nuclear fusion end at the white dwarf.
3) The extra large mass of Jupiter has been explained as the result of the ice-evap-line expansion. All ice mass in {1,n=2..6} super-shell evaporated because of this, and most of the evaporated ice mass was captured by Jupiter.
4) The original mass from {1,2} to {4,6} shells in Solar {N,n} QM structure has been calculated out through modeling. the mass density vs. r is determined to be: D = 4.37E+28 / r^3.279 (kg/m^3). The unknown {3,n=2..5} planets/belts is predicted to exist, and their mass has been estimated to be 12×, 7×, 5× and 3× of Earth mass according to this model.
5) Asteroid belt is assigned to be {1,8}o orbit in Solar {N,n} QM structure.
6) The Solar QM {N,n} (mass) structure collapse is accompanied by the Solar QM {N,n} (heat) structure expansion.

References

[1] A series of my papers that to be published (together with current paper):
SunQM-1: Quantum mechanics of the Solar system in a {N,n//6} QM structure.
SunQM-1s1: The dynamics of the quantum collapse (and quantum expansion) of Solar QM {N,n} structure.
SunQM-1s2: Comparing to other star-planet systems, our Solar system has a nearly perfect {N,n//6} QM structure.
SunQM-1s3: Applying {N,n} QM structure analysis to planets using exterior and interior {N,n} QM.
SunQM-2: Expanding QM from micro-world to macro-world: general Planck constant, H-C unit, H-quasi-constant, and the meaning of QM.
SunQM-3: Solving Schrodinger equation for Solar quantum mechanics {N,n} structure.
SunQM-3s1: Using 1st order spin-perturbation to solve Schrodinger equation for nLL effect and pre-Sun ball's disk-lyzation.
SunQM-3s2: Using {N,n} QM model to calculate out the snapshot pictures of a gradually disk-lyzing pre-Sun ball.
SunQM-3s3: Using QM calculation to explain the atmosphere band pattern on Jupiter (and Earth, Saturn, Sun)'s surface.
SunQM-3s6: Predict radial mass density distribution for Earth, planets, and Sun based on {N,n} QM probability distribution.
SunQM-5: C-QM (a new version of QM based on interior {N,n}, multiplier n', |R(n,l)|^2 |Y(l,m)|^2 guided mass occupancy, and RF) and its application from string to universe.
SunQM-5s1: White dwarf, neutron star, and black hole re-analyzed by using C-QM.

[2] The citation of wiki "Solar core" means it is obtained from the Wikipedia online searching for "Solar core". Its website address is: https://en.wikipedia.org/wiki/Solar_core. This website address can be generalized for all other searching items.

[3] From wiki "Asteroid belt": "*The Asteroid belt showing the orbital inclinations versus distances from the Sun, with asteroids in the core region of the asteroid belt in red and other asteroids in blue*". The diagram was created by Piotr Deuar using orbit data for 120437 numbered minor planets from the Minor Planet Center orbit database, dated 8 Feb 2006. Copy right: "CC BY-SA 3.0" at, https://creativecommons.org/licenses/by-sa/3.0/

[4] Major QM books, data sources, software I used for this study are:
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John S. Townsed, A Modern Approach to Quantum Mechanics, 2nd ed., 2012.
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Journal: Scientific American.