Chapter 9

Applying CFLE Theory to the Solar System

9.1. Quantization of the Planetary Orbit by CFLE Theory

A particular quantum mechanical system is described by a particular potential energy function, assuming that the potentials are time-independent. This function can be written as $V(x)$. The Schrödinger equation for the potential leads immediately to the corresponding time-independent Schrödinger equation, an acceptable solution of which exists only if the energy is listed in order of increasing energy,

$$E_1, E_2, E_3, ---E_n ---$$

These energy values are the eigenvalues of the potential $V(x)$, where a particular potential has a particular set of eigenvalues. The eigenvalue early in the list may be discretely separate in energy. Corresponding to each eigenvalue is an eigenfunction

$$\psi_1(x), \psi_2(x), \psi_3(\mathrm{x}) --- \psi_n(x) --- \qquad 9\text{-}1\text{-}1$$

that is a solution to the time-independent Schrödinger equation for the potential $V(x)$. For each eigenvalue, there is also a corresponding wave function

$$\psi_1(x,t)\psi_2(x,t)\psi_3(x,t) --- \psi_n(x,t) --- \qquad 9\text{-}1\text{-}2$$

Because $\psi(x,t) = \psi(x)\mathrm{e}^{-iEt/\hbar}$, these wave functions are

$$\psi_1(x)\mathrm{e}^{iE_1t/\hbar}, \psi_2(x)\mathrm{e}^{iE_2t/\hbar}, \psi_3(x)\mathrm{e}^{iE_3t/\hbar} --- \psi_n(x)\mathrm{e}^{iE_nt/\hbar} \qquad 9\text{-}1\text{-}3$$

Each wave function is a solution of the Schrödinger equation for the potential $V(x)$. The index n, which takes on successive integral values, and which is employed to designate a particular eigenvalue and its corresponding eigenfunction and wave function, is called the quantum number. If the system is described by the wave function $\psi(x, t)$, then it is said to be in the quantum state n. When the one-electron atom eigenfunctions are expressed in terms of the parameter

$a_o = \frac{4\pi\varepsilon_o\hbar^2}{\mu e^2} = 0.529 \times 10^{-10} = 0.529$ Å 9-1-4

we can obtain the eigenfunctions listed in Table 9-1-1.

n	l	m_l	Eigen function
1	0	0	$\psi_{100} = \frac{1}{\sqrt{\pi}}(\frac{z}{a_o})^{3/2} e^{-zr/a_o}$
2	0	0	$\psi_{200} = \frac{1}{4\sqrt{2\pi}}(\frac{z}{a_o})^{3/2}(2 - \frac{zr}{a_o}) e^{-zr/2a_o}$
2	1	0	$\psi_{210} = \frac{1}{4\sqrt{2\pi}}(\frac{z}{a_o})^{3/2}\frac{zr}{a_o} e^{-zr/2a_o}\cos\theta$
2	1	±1	$\psi_{21\pm1} = \frac{1}{8\sqrt{\pi}}(\frac{z}{a_o})^{3/2}\frac{zr}{a_o} e^{-zr/2a_o}\sin\theta e^{\pm i\varphi}$
3	0	0	$\psi_{300} = \frac{1}{81\sqrt{3\pi}}(\frac{z}{a_o})^{3/2}\frac{zr}{a_o}(27 - 18\frac{zr}{a_o} + \frac{z^2r^2}{a_o}) e^{-zr/3a_o}$
3	1	0	$\psi_{310} = \frac{\sqrt{2}}{81\sqrt{\pi}}(\frac{z}{a_o})^{3/2}\frac{zr}{a_o}(6 - \frac{zr}{a_o})\frac{zr}{a_o} e^{-zr/3a_o}\cos\theta$
3	1	±1	$\psi_{31\pm1} = \frac{1}{81\sqrt{\pi}}(\frac{z}{a_o})^{3/2}\frac{zr}{a_o}(6 - \frac{zr}{a_o})\frac{zr}{a_o} e^{-zr/3a_o}\sin\theta e^{\pm i\varphi}$
3	2	0	$\psi_{320} = \frac{1}{81\sqrt{6\pi}}(\frac{z}{a_o})^{3/2}\frac{z^2r^2}{a_o} e^{-zr/3a_o}(3\cos\theta - 1)$
3	2	±1	$\psi_{32\pm1} = \frac{1}{81\sqrt{\pi}}(\frac{z}{a_o})^{3/2}\frac{z^2r^2}{a_o} e^{-zr/3a_o}\sin\theta\cos\theta e^{\pm i\varphi}$
3	2	±2	$\psi_{32\pm2} = \frac{1}{162\sqrt{\pi}}(\frac{z}{a_o})^{3/2}\frac{z^2r^2}{a_o} e^{-zr/3a_o}\sin^2\theta e^{\pm i\varphi}$

Table 9-1-1. Eigen function values.

Because the correspondence principal assumes that the electromagnetic force and gravitomagnetic force are qualitatively the same and thus unified, these results of quantum dynamics can apply to the solar system, as discussed in §8. The only requirement is that the proper parameter of quantum dynamics be changed by the quantization number of CFLE theory for the solar system parameter. That is

$a_\odot = (5.291 \times 10^{-11}$ m$) (1.686044 \times 10^{21})$

$= 8.921 \times 10^{10}$ m 9-1-5

The gravitational permittivity of air at the correspondence number $c_c = 1.5$ (cf. §5,§24,§TB25) and the electrical permittivity of air at $g = \frac{6.545979}{1.5} = 4.363986$ are

$Q_g = (0.016774)\ (1.5) = 0.025161$

$x_g = 1.025161$

$Q_e = (0.000589)\ (4.363986) = 0.002570$

$x_e = 1.002570$

The parameter is

$$a_{\odot} = \frac{8.921 \times 10^{10}\ \text{m}}{(1.025161)\ (1.002570)}$$

$= 5.834\ \ \text{x}10^{10}$ m 9-1-6

The observed value is

$a_{\odot} = 5.834 \times 10^{10}$ m = 0.39Au 9-1-7

where 1Au = 1.496×10^{11} m

According to the energy quantization formula discussed in §7

$E = g\ (n + \frac{1}{2})\ \hbar\omega, \qquad n = 0,1,2,3,\cdots$ 9-1-8

This formula can be expressed with the parameter "$a_{\odot}$" too. That is,

$$a_n = \pm g\ (n + \tfrac{1}{2})\ a_{\odot}$$

Because $a_{\odot}$ = 0.39Au, the general form of the formula is

$a_n = \pm g\ (n + \frac{1}{2})$ 0.39Au 9-1-9

Because this is a quantized general formula, we should able to express this formula for the orbital radius of planets of the solar system, as is applied in the following sections.

A: strongo-gravitational orbits

(1) *Mercury*

Because according to the general formula the energy state of Mercury is $n = 0$, $g = 2$, so the planetary orbit radius of Mercury is

$$a_o = g\,(n + \frac{1}{2})\,a_\odot$$

$$= 2(0 + \frac{1}{2})\,0.39\text{Au} = 0.39\text{Au} \qquad 9\text{-}1\text{-}10$$

(2) *Venus*

Similarly, the energy state of Venus is $n = 1$, $g = 1$, so

$$a_1 = g\,(n + \frac{1}{2})\,a_\odot$$

$$= 1(1 + \frac{1}{2})\,0.39\text{Au} = 0.59\text{Au} \qquad 9\text{-}1\text{-}11$$

However, the observed value for Venus is $a = 0.72$Au, and thus the temporal force line curve of Venus cannot be $g = 1$. The temporal force line curve of Venus by perturbation is

$$a_1 = g\,(n + \frac{1}{2})\,a_\odot$$

$$= g\,(1+0.5)\,0.39\text{Au} = 0.72\text{Au}$$

$$g = \frac{0.72}{0.59} = 1.23$$

The force line curve of the micro world is oscillated around $g \sim 1$ in a very short time period, and the value of $g = 1$ is only a statistical value based on the uncertainty principle. Because a force line curve of 1 revolution cannot be exactly $g = 1$ by perturbation, such unlimited accuracy is not permitted by the quantum nature of the universe. That is why in the macro world we can have a force line curve value that is not an exact integer under the condition of temporality. However, the statistical value of the quantized time interval should be $g = 1$.

Therefore, the required formula is

$a_1 = g\ (n + \frac{1}{2})\ a_{\odot}$

$= 1.23(1 + 0.5)\ 0.39\text{Au} = 0.72\text{Au}$ 9-1-12

(3) *Earth*

The energy state for Earth is $n = 2$, $g = 1$, so

$a_2 = g\ (n + \frac{1}{2})\ a_{\odot}$

$= 1(2 + 0.5)\ 0.39\text{Au} = 0.98\text{Au}$ 9-1-13

Because, by definition, the unit distance is 1Au, the temporal force line curve of Earth by perturbation is

$a_2 = g\ (2 + 0.5)\ 0.39 = 1\text{Au}$

$g = 1.03$ 9-1-14

Therefore, the required formula is

$a_2 = g\ (n + \frac{1}{2})\ a_{\odot}$

$= 1.03(2 + 0.5)\ 0.39\text{Au} = 1\text{Au}$ 9-1-15

(4) *Mars*

The energy state for Mars is $n = 3$, $g = 1$, so

$a_3 = g\ (n + \frac{1}{2})\ a_{\odot}$

$= 1(3 + 0.5)\ 0.39\text{Au} = 1.37\text{Au}$ 9-1-16

Because the real observed value is $a = 1.52\text{Au}$, the temporal force line curve of Mars by perturbation must be

$a = g\ (3 + 0.5)\ 0.39\text{AU} = 1.52\text{Au}$

$g = 1.11$ 9-1-17

The required formula is

$a_3 = g\ (n + \frac{1}{2})\ a_{\odot}$

$= 1.11(3 + 0.5)0.39\text{Au} = 1.52\text{Au}$ 9-1-18

(5) Early ***Theia***

The energy state for early Theia is guessed$n = 5$, $g = 1$, so

$a_4 = g\ (4+\frac{1}{2})\ a_{\odot}$

$= 1(4 + 0.5)\ 0.39\text{Au} = 1.76\text{Au}$ 9-1-19

During solar system genesis Theia's orbit was disturbed by early Jupiter and Venus for solar principle quantum number to satisfy into a collision with the early Earth. Theia struck Earth with a glancing blow and ejected many pieces of both Earth and Theia. These pieces either formed one body that became the Moon, or formed two moons that eventually merged to form the Moon.

(6) Early ***Io***

The energy state for early Io is guessed $n = 5$, $g = 1$, so

$a_5 = = g\ (5+\frac{1}{2})\ a_{\odot}$

$= 1(5 + 0.5)\ 0.39\text{Au} = 2.15\text{Au}$ 9-1-20

During solar system genesis early Io's orbit was disturbed by early Jupiter and Saturn for solar principle quantum number to satisfy into a capture with the early Jupiter. Unlike most satellites in the outer Solar System, which are mostly composed of water ice, Io is primarily composed of silicate rock surrounding a molten iron or iron sulfide core. With over 400 active volcanoes, Io is the most geologically active object in the Solar System. Composed primarily of silicate rock and iron, Io is closer in bulk composition to the terrestrial planets than to other satellites in the outer Solar System, which are mostly composed of a mix of water ice and silicates. Io has a density of 3.5275 g/cm^3, the highest of any moon in the Solar System; significantly higher than the other Galilean satellites and higher than the Moon.

(7) ***Asteroidsbelt of Europa***

The energy state of an asteroid is guessed n = 6, n=6×1 $g = 1$, so

$a_6 = g\,(6 + \frac{1}{2})\,a_\odot$

$= 1(6 + 0.5)0.39\text{Au} = 2.54\text{Au}$ 9-1-21

The real observed value is 2.64Au, and thus the temporal force line curve by perturbation must be

$a_6 = g\,(n + \frac{1}{2})\,a_\odot$

$= g\,(6.5)\;0.39\text{Au} = 2.64\text{AU}$

$g = 1.04$

The required formula is

$a_6 = g\,(n + \frac{1}{2})\,a_\odot$

$= 1.04(6 + 0.5)\;0.39\text{Au} = 2.64\text{Au}$ 9-1-22

During solar system genesis early Europa's orbit was disturbed by early Jupiter and Saturn for solar principle quantum number to satisfy into a capture with the early Jupiter. After capture of Europa remained Asteriods nowadays orbit. Slightly smaller than the Moon, Europa is primarily made of silicate rock and has a water-ice crust and probably an iron–nickel core. It has a tenuous atmosphere composed primarily of oxygen. Its surface is striated by cracks and streaks, whereas craters are relatively rare. It has the smoothest surface of any known solid object in the Solar System. The apparent youth and smoothness of the surface have led to the hypothesis that a water ocean exists beneath it, which could conceivably serve as an abode for extraterrestrial life. In December 2013, NASA reported the detection of "clay-like minerals" (specifically, phyllosilicates), often associated with "organic material" on the icy crust of Europa. Europa has emerged as one of the top locations in the Solar System in terms of potential habitability and the possibility of hosting life. Life could exist in its under-ice ocean, perhaps subsisting in an environment similar to Earth's deep-ocean hydrothermal vents. Life in such an ocean could possibly be similar to microbial life on Earth in the deep ocean. So far, there is no evidence that life exists on Europa, but the likely presence of liquid water has spurred calls to send a probe there.

B: electro-gravitational orbits

(8) ***Jupiter***

The energy state for Jupiter is $n = 6 \times 2$, $g = 1$, so

$$a_{(6\times2)} = g\,(n + \tfrac{1}{2})\,a_\odot$$

$$= 1(12 + 0.5)\ 0.39\text{Au} = 4.88\text{Au} \qquad 9\text{-}1\text{-}23$$

Because the real observed value is $a = 5.20$Au, the temporal force line curve by perturbation must be

$$a_{(6\times2)} = g\,(n + \tfrac{1}{2})\,a_\odot$$

$$= g\ (12 + 0.5)\ 0.39\text{Au} = 5.20\text{Au}$$

$g = 1.066$

The required formula is

$$a_{(6\times2)} = g\,(n + \tfrac{1}{2})\,a_\odot$$

$$= 1.066(12 + 0.5)0.39\text{Au} = 5.20\text{Au} \qquad 9\text{-}1\text{-}24$$

(9) ***Centaursbelt 1***

The energy state for Centaurs's belt 1 is $n = 6 \times 3$, $g = 1$, so

$$a_{(6\times3)} = g\,(18 + \tfrac{1}{2})\,a_\odot$$

$$= 1(18 + 0.5)\ 0.39\text{Au} = 7.22\text{Au} \qquad 9\text{-}1\text{-}25$$

During solar system genesis early Centaurs 1 's orbit was rather wide by early Jupiter's gravitation for solar principle quantum number to satisfy. The centaurs are icy comet-like bodies. The largest known centaur, 10199 Chariklo, has a diameter of about 250 km. The first centaur discovered, 2060 Chiron, has also been classified as comet (95P) because it develops a coma just as comets do when they approach the Sun.

(10) ***Saturn***

The energy state for Saturn is $n = 6 \times 4$, $g = 1$, so

$$a_{(6\times4)} = g\,(n + \tfrac{1}{2})\,a_{\odot}$$

$$= 1(24 + 0.5)\ 0.39\text{Au} = 9.56\text{Au} \qquad 9\text{-}1\text{-}26$$

Because the real observed value is a = 9.56Au, the temporal force line curve is found

$$g = 1 \qquad 9\text{-}1\text{-}27$$

(11) ***Centerursbelt 2***

The energy state for Centaurs's is $n = 6 \times 5$, $g = 1$, so

$$a_{(6\times5)} = g\,(30 + \tfrac{1}{2})\,a_{\odot}$$

$$= 1(30 + 0.5)\ 0.39\text{Au} = 11.90\text{Au} \qquad 9\text{-}1\text{-}28$$

During solar system genesis early Centaurs 2's orbit was rather wide by early Saturn's gravitation for solar principle quantum number to satisfy. The centaurs are icy comet-like bodies.

(12) ***Uranus***

The energy state for Uranus is $n = 6 \times 6$, n=6×6×1,$g = 1$, so

$$a_{(6\times6)} = g\,(n + \tfrac{1}{2})\,a_{\odot}$$

$$= 1\ (36 + 0.5)\ 0.39\text{Au} = 14.24\text{Au} \qquad 9\text{-}1\text{-}29$$

Because the real observed value is a = 19.2Au, the temporal force line curve by perturbation must be

$$a_{(6\times6)} = g\,(n + \tfrac{1}{2})\,a_{\odot}$$

$$= g\ (36 + 0.5)\ 0.39\text{Au} = 19.22\text{Au}$$

$$g = 1.35$$

Hence, the required formula is

$a_{(6\times6)} = g\,(n + \frac{1}{2})\,a_{\odot}$

$$=1.35(36 + 0.5)\ 0.39\text{Au} = 19.22\ \text{Au} \qquad 9\text{-}1\text{-}30$$

C: weako- gravitational orbit

(13) ***Neptune***

The energy state for Neptune is $n = 6 \times 6 \times 2$, $g = 1$, so

$a_{(6\times6\times2)} = g\,(n + \frac{1}{2})\,a_{\odot}$

$$= 1(72 + 0.5)\ 0.39\text{Au} = 28.28\text{Au} \qquad 9\text{-}1\text{-}31$$

Because the real observed value is $a = 30.11$Au, the temporal force line curve value by perturbation must be

$a_{(6\times6\times2)} = g\,(n + \frac{1}{2})\,a_{\odot}$

$$= g\ (72 + 0.5)\ 0.39\text{Au} = 30.11\text{Au}$$

$g = 1.065$

So, the required formula is

$a_{(6\times6\times2)} = g\,(n + \frac{1}{2})\,a_{\odot}$

$$= 1.065\ (72 + 0.5)\ 0.39\text{Au} = 30.11\text{Au} \qquad 9\text{-}1\text{-}32$$

For probability density function of solar system to satisfy must be exist only 8 energy level according to Eq 9-4-1

$N = 2(n^2)$

$$= 2(2\ )^2 = 8 \qquad 9\text{-}4\text{-}1$$

Other objects in other energy levels of solar system are called Gravitational Probability Density Function objects (GPDF objects).

Electron doesn't have any substructure, but can have system with light particles that is called weaktron as Earth and Moon according to correspondence principle of CFLE theory.

Therefore, from here we talking about such GPDE objects and its GPDF energy levels

(14) ***Pluto belt***

The energy state of Pluto belt is $n = 6 \times 6 \times 3$, $g = 1$, so

$$a_{(6\times6\times3)} = g\ (108+\frac{1}{2})\ a_{\odot}$$

$$= 1(108 + 0.5)\ 0.39\text{Au} = 42.32\text{Au} \qquad 9\text{-}1\text{-}33$$

Because the observed value is a = 39.35Au, the temporal force line curve by perturbation must be

$$a_{(6\times6\times3)} = g\ (n+\frac{1}{2})\ a_{\odot}$$

$$= g\ (108 + 0.5)\ 0.39\text{Au} = 39.35\text{Au}$$

$g = 0.93$

Therefore, the required formula is

$$a_{(6\times6\times3)} = g\ (n+\frac{1}{2})\ a_{\odot}$$

$$= 0.93(108 + 0.5)\ 0.39\text{Au} = 39.35\text{Au} \qquad 9\text{-}1\text{-}34$$

Because Pluto as GPDE object has a long narrow elliptical orbit, it can have a negative force line curve. The fluctuation of force line curves of the solar planets around g =1 is not an essential difference of particle physics. Particle physics can have particle fluctuation of force line curves around g = 1, but these results show only the probability of wave mechanics. Therefore, the fluctuation of the solar planetary force line curve around g = 1 is only a temporal value. The important point is that this temporal value is not fixed. Because the solar system is 1.686×10^{21} times (cf. §9.4) bigger than the atomic system, fluctuations of such force line curves around g = 1 in the solar system are 1.686×10^{21} times slower than in the atomic system.

(15) *Kuiper belt*

The energy state of Kuiper belt is $n = 6 \times 6 \times 4$, $g = 1$, so

$a_{(6\times6\times4)} = g\ (144+\frac{1}{2})\ a_{\odot}$

= 1(108 + 0.5) 0.39Au = 56.36Au

Because of influence of keplerian missing factor f_k =1.202(cf.11.5.4) for far distant from the Sun effective radius is

$a_{(6\times6\times4)} = 56.36$ Au $\times 0.832$

= 46.89Au 9-1-35

The Kuiper belt is a great ring of debris similar to the asteroid belt, but consisting mainly of objects composed primarily of ice. It extends between 30 and 50 AU from the Sun.

(16) *Scattered disk belt*

The energy state of scattered disk belt is $n = 6 \times 6 \times 5$, $g = 1$, so

$a_{(6\times6\times5)} = g\ (144+\frac{1}{2})\ a_{\odot}$

= 1(180+ 0.5) 0.39Au = 70.40Au

Because of influence of keplerian missing factor f_k =1.202(cf.11.5.4) for far distant from the Sun effective radius is

$a_{(6\times6\times4)} = 70.40$ Au $\times 0.832$

= 58.57Au 9-1-36

(17) *Extended Scattered disk belt*

The energy state of Extended scattered disk belt is $n = 6 \times 6 \times 6$, $g = 1$, so

$a_{(6\times6\times6)} = g\ (216+\frac{1}{2})\ a_{\odot}$

= 1(216+ 0.5) 0.39Au = 84.44Au

Because of influence of keplerian missing factorf_k =1.202(cf.11.5.4) for far distant from the Sun effective radius is

$a_{(6\times6\times6)}$ =84.44 Au ×0.832

= 70.25Au 9-1-37

The scattered disc,which overlaps the Kuiper belt but extends much further outwards, is thought to be the source of short-period comets. Scattered disc objects are believed to have been ejected into erratic orbits by the gravitational influence of Neptune's early outward migration. Most scattered disc objects (SDOs) have perihelia within the Kuiper belt but aphelia far beyond it (some more than 150 AU from the Sun). SDOs' orbits are also highly inclined to the ecliptic plane and are often almost perpendicular to it. Some astronomers consider the scattered disc to be merely another region of the Kuiper belt and describe scattered disc objects as "scattered Kuiper belt objects". Some astronomers also classify centaurs as inward-scattered Kuiper belt objects along with the outward-scattered residents of the scattered disc.

Eris (68 AU average) is the largest known scattered disc object, and caused a debate about what constitutes a planet, because it is 25% more massive than Pluto and about the same diameter. It is the most massive of the known dwarf planets. It has one known moon, Dysnomia. Like Pluto, its orbit is highly eccentric, with a perihelion of 38.2 AU (roughly Pluto's distance from the Sun) and an aphelion of 97.6 AU, and steeply inclined to the ecliptic plane.

D: gravito-gravitational orbits

(18) *GG2 belt*

The energy state of scattered belt is $n = 6 \times 6 \times 6\times 2$, $g = 1$, so

$a_{(6\times6\times6\times2)} = g\ (432+\frac{1}{2})\ a_{\odot}$

= 1(432+ 0.5) 0.39Au = 168.7Au

Because of influence of keplerian missing factorf_k =1.202(cf.11.5.4) for far distant from the Sun effective radius is

$a_{(6\times6\times6\times2)}$ =168.7 Au ×0.832

= 140.4Au 9-1-38

The point at which the Solar System ends and interstellar space begins is not precisely defined because its outer boundaries are shaped by two separate forces: the solar wind and the Sun's gravity. The outer limit of the solar wind's influence is roughly four times Pluto's distance from the Sun; this *heliopause* is considered the beginning of the interstellar medium The Sun's Hill sphere, the effective range of its gravitational dominance, is believed to extend up to a thousand times farther.

The heliosphere is divided into two regions; the solar wind travels at roughly 400 km/s until it collides with the interstellar wind; the flow of plasma in the interstellar medium. The collision occurs at the termination shock, which is roughly 80–100 AU from the Sun upwind of the interstellar medium and roughly 200 AU from the Sun downwind.

(19)*GG3 belt*

The energy state of scattered belt is $n = 6 \times 6 \times 6 \times 3$, $g = 1$, so

$a_{(6\times6\times6\times3)} = g\ (648 + \frac{1}{2})\ a_{\odot}$

= 1(432+ 0.5) 0.39Au = 252.9Au

Because of influence of keplerian missing factorf_k =1.202(cf.11.5.4) for far distant from the Sun effective radius is

$a_{(6\times6\times6\times3)}$ =252.9 Au ×0.832

=210.4Au 9-1-39

(20)*GG4 belt*

The energy state of scattered belt is $n = 6 \times 6 \times 6 \times 4$, $g = 1$, so

$a_{(6\times6\times6\times4)} = g\ (864 + \frac{1}{2})\ a_{\odot}$

= 1(864+ 0.5) 0.39Au = 337.2Au

Because of influence of keplerian missing factor f_k =1.202(cf.11.5.4) for far distant from the Sun effective radius is

$$a_{(6\times6\times6\times4)} = 337.2 \text{ Au} \times 0.832$$

$$=280.6\text{Au} \qquad 9\text{-}1\text{-}40$$

(21)*GG5 belt*

The energy state of scattered belt is $n = 6 \times 6 \times 6 \times 5$, $g = 1$, so

$$a_{(6\times6\times6\times5)} = g\,(1080+\tfrac{1}{2})\,a_\odot$$

$$= 1(1080+ 0.5)\ 0.39\text{Au} = 421.4\text{Au}$$

Because of influence of keplerian missing factor f_k =1.202(cf.11.5.4) for far distant from the Sun effective radius is

$$a_{(6\times6\times6\times5)} = 421.4 \text{ Au} \times 0.832$$

$$=350.1\text{Au} \qquad 9\text{-}1\text{-}41$$

(22)*GG6 belt*

The energy state of scattered belt is $n = 6 \times 6 \times 6 \times 6$, $g = 1$, so

$$a_{(6\times6\times6\times6)} = g\,(1296+\tfrac{1}{2})\,a_\odot$$

$$= 1(1296+ 0.5)\ 0.39\text{Au} = 505.6\text{Au}$$

Because of influence of keplerian missing factor f_k =1.202(cf.11.5.4) for far distant from the Sun effective radius is

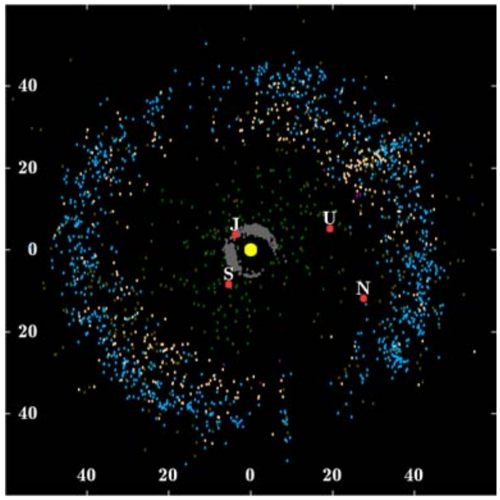
$$a_{(6\times6\times6\times6)} = 505.6 \text{ Au} \times 0.832$$

$$=420.7\text{Au} \qquad 9\text{-}1\text{-}42$$

90377 Sedna (520 AU average) as distant detached objects is a large, reddish object with a gigantic, highly elliptical orbit that takes it from about 76 AU at perihelion to 940 AU at aphelion and takes 11,400 years to complete.

sometimes termed "distant detached objects" (DDOs), which also may include the object 2000 CR, which has a perihelion of 45 AU, an aphelion of 415 AU, and an orbital period of 3,420 years.

9.2. Solving Problem of Kuiper Cliff by CFLE theory

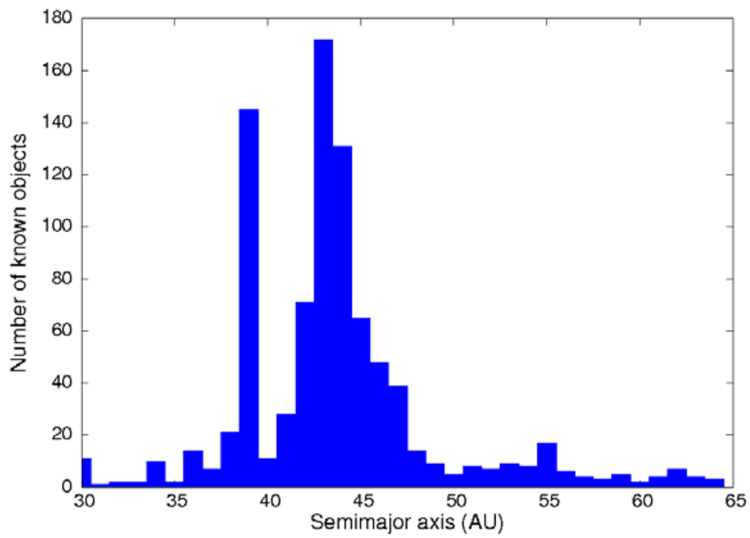


Known objects in the Kuiper belt beyond the orbit of Neptune (scale in Au). J is Jupiter, S is Saturn, U is Uranus, and N is Neptune.

Figure 9-2-1

Based on estimations of the primordial mass required to form Uranus and Neptune, as well as bodies as large as Pluto, earlier models of the Kuiper belt had suggested that the number of large objects would increase by a factor of two beyond 50 AU, so this sudden drastic falloff, known as the "Kuiper cliff", was completely unexpected, and its cause, to date, is unknown. in 2003, Bernstein and Trilling et al. found evidence that the rapid decline in objects of 100 km or more in radius beyond 50 AU is real, and not due to observational bias. Possible explanations include that material at that distance was too scarce or too scattered to accrete into large objects, or that subsequent processes removed or destroyed those that did. Patryk Lykawka of Kobe University has claimed that the gravitational attraction of an unseen large planetary object, perhaps the size of Earth or Mars, might be responsible. However, generally acceptable theory is not given to date.

Therefore, problem of kuiper cliff becomes one of unsolved problem in physics as why does the number of objects in the Solar System's Kuiper belt fall off rapidly and unexpectedly beyond a radius of 50 astronomic units?



Graph showing the numbers of KBOs for a given distance from the Sun. The plutinos are the "spike" at 39 AU, whereas the classicals are between 42 and 47 AU, the twotinos are at 48 AU, and the 5:2 resonance is at 55 AU.

Figure 9-2-2

When an object's orbital period is an exact ratio of Neptune's (a situation called a mean-motion resonance), then it can become locked in a synchronised motion with Neptune and avoid being perturbed away if their relative alignments are appropriate. If, for instance, an object orbits the Sun twice for every three Neptune orbits, and if it reaches perihelion with Neptune a quarter of an orbit away from it, then whenever it returns to perihelion, Neptune will always be in about the same relative position as it began, because it will have completed 1 ½ orbits in the same time. This is known as the 2:3 (or 3:2) resonance, and it corresponds to a characteristic semi-major axis of about 39.4 AU. This 2:3 resonance is populated by about 200 known objects, including Pluto together with its moons. In recognition of this, the members of this family are known as plutinos. Many plutinos, including Pluto, have orbits that cross that of Neptune, though their resonance means they can never collide. Plutinos have high orbital eccentricities, suggesting that they are not native to their current positions but were instead thrown haphazardly into their orbits by the migrating Neptune.IAU guidelines dictate that all plutinos must, like Pluto, be named for underworld deities. The 1:2 resonances (whose objects complete half an orbit for each of Neptune's) correspond to semi-major axes of ~47.7AU, and is sparsely populated. Its residents are sometimes referred to as twotinos. Other resonances also exist at 3:4, 3:5, 4:7 and 2:5. Neptune possesses a number of trojan objects, which occupy its ${}_4$ and L_5 points; gravitationally stable regions leading and trailing it in its orbit. Neptune trojans are often described as being in a 1:1 resonance with Neptune. Neptune trojans typically have very stable orbits.

Additionally, there is a relative absence of objects with semi-major axes below 39 AU that cannot apparently be explained by the present resonances. The currently accepted hypothesis for the cause of this is that as Neptune migrated outward, unstable orbital resonances moved gradually through this region, and thus any objects within it were swept up, or gravitationally ejected from it.

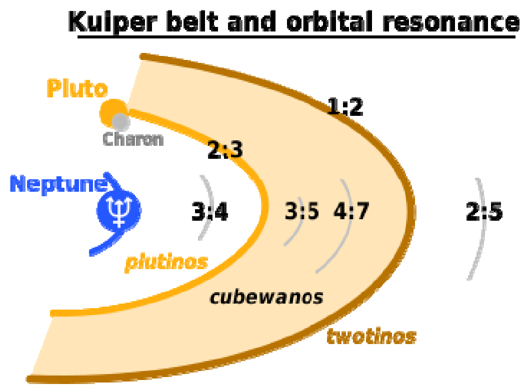
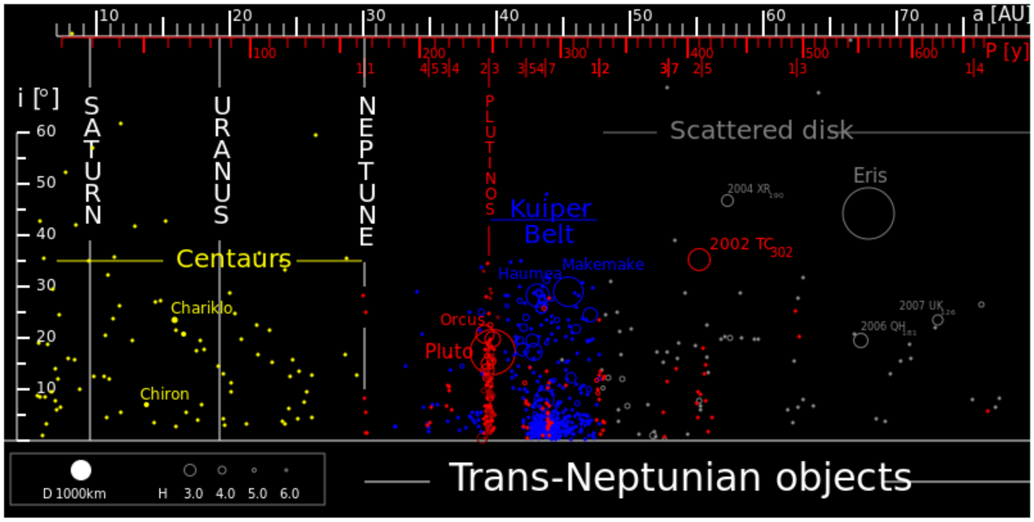


Figure 9-2-3

Figure 9-2-3 show orbital resonance of kuiper belt by Neptune. The 1:2 resonances appear to be an edge beyond which few objects are known. It is not clear whether it is actually the outer edge of the classical belt or just the beginning of a broad gap. Objects have been detected at the 2:5 resonances at roughly 55 AU, well outside the classical belt.

However, predictions of a large number of bodies in classical orbits between these resonances have not been verified through observation.



Distribution of cubewanos(39Au) , Resonant trans-Neptunian objects (40~50Au) and near scattered objects.

Figure 9-2-4

Figure 9-2-4 show results of observation. As part of our ongoing Deep Ecliptic Survey (DES) of the Kuiper belt, E.I Chiang et al reported on the occupation of the 1:1 (Trojan), 4:3, 3:2, 7:4, 2:1, and 5:2 Neptunian mean-motion resonances (MMRs). The previously unrecognized occupation of the 1:1 and 5:2 MMRs is not easily understood within the standard model of resonance sweeping by a migratory Neptune over an initially dynamically cold belt. Among all resonant Kuiper belt objects (KBOs), the three observed members of the 5:2 MMR discovered by DES possess the largest semi-major axes (a ≈ 55.4AU), the highest eccentricities (e ≈ 0.4), and substantial orbital inclinations (i ≈ 10°). Objects (38084) $1999HB_{12}$ and possibly $2001KC_{77}$ can librate with modest amplitudes of ~90° within the 5:2 MMR for at least 1 Gyr. Their trajectories cannot be explained by close encounters with Neptune alone, given the latter's current orbit. The dynamically hot orbits of such 5:2 resonant KBOs, unlike hot orbits of previously known resonant KBOs, may imply that these objects were pre-heated to large inclination and large eccentricity prior to resonance capture by a migratory Neptune. Our first discovered Neptunian Trojan,

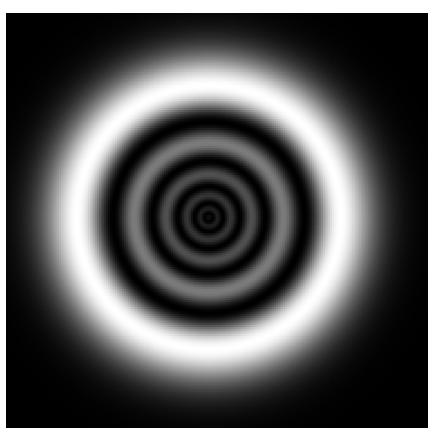
$2001QR_{322}$, may not owe its existence to Neptune's migration at all. The trajectory of $2001QR_{322}$ is remarkably stable; the object can undergo tadpole type libration about Neptune's leading Lagrange (L4) point for at least 1 Gyr with a libration amplitude of 24°. Trojan capture probably occurred while Neptune accreted the bulk of its mass. For an assumed albedo of 12–4%, Trojan is ~130–230 km in diameter. Model-dependent estimates place the total number of Neptune Trojans resembling 2001QR322 at ~ 20–60. Their existence might rule out violent orbital histories for Neptune.

The fraction of objects located beyond a_* is

$$f \equiv \frac{\Sigma(a>a_*)}{\Sigma(a>a_{min})} = (\frac{a_{min}}{a_*})^{\gamma}(1+o\left\{[\frac{s_m(a_*)}{s_{max}}]^{\gamma/2}\right\}) \quad 9\text{-}2\text{-}1$$

where $\gamma = 2q + \beta - 5$

The order-of-magnitude correction term is valid for $\beta \leq 3$ and is small for surveys and distributions considered here. The fraction f is thus insensitive to the limiting magnitude of the field. This insensitivity justifies assertion that a Kuiper Cliff would not break the luminosity function at any particular magnitude. It also allows us to easily estimate how much detection beyond 50 AU astronomer might expect. For $a_{min} = 30$ AU, $a_* = 50$AU, $s_{max} = 2000$ km, $q = 3.6$, and β =3 (constant dispersion in e and i), the fraction of objects outside 50 AU is f =8%. Decreasing the distance index β to 2 increases f to 13%. In the present total sample of ~100 KBOs, they might therefore expect ~10 to reside beyond 50 AU. Eight of these ten would be located between 50 and 70 AU. By such fine DES and other studies kuiper cliff is appeared clearly as today. One important point is that by resonance occupation theory kuiper cliff is founded. However, resonance occupation theory cannot explain gap of kuiper cliff. According to CFLE theory the sun and its orbits has to have wave property. With this wave nature of the Sun astronomer can try to explain problem of kuiper cliff.



Cross-section of computed hydrogen atom orbital ($\psi(r, \theta, \varphi)^2$) for the 6s ($n = 6$, $\ell = 0$, $m = 0$) orbital. Note that s orbitals, though spherically symmetrical, have radially placed wave-nodes for $n > 1$. However, only s orbitals invariably have a center anti-node; the other types never do.

Figure 9-2-5

When Kuiper cliff should corresponded node area of atomic orbital according to CFLE theory, we could answer about problem of kuiper cliff at 50 Au. Kuiper cliff can be node area of sun's gravitational probability density function, because according to quantum wave mechanics in node any objects cannot exist probably. According to §9.2 Kuiper cliff is between 46.89Au of 15th energy level of kuiper belt and 58.57Au of 16th energy level of scattered disk belt. Energy level of scattered disk belt permit 2:5 resonances occupy by Neptune at 55Au.Such agreed quantity by CFLE theory gives enough assurance to introduce of wave property for problem of kuiper cliff to solve.

Conclusion: solar system has wave property.

9.3. Definition for the End of the Solar System by CFLE Theory

The energy level of a hydrogen atom is $n = 1$, but the real maximum quantum number by transition is permitted to $n = 6$, therefore, the end of the hydrogen atom is $n = 6$. outside of $n = 6$, an electron is free from potential. Because the sun corresponds to huge proton, it can be defined as in the case of the hydrogen atom. Therefore, the effective maximum gravitational magnetic radius of the sun is started from gravito-gravitational energy level$n = 6 \times 6 \times 6 \times 2$. From this energy level pure gravitational field and related gravitational magnet (magnet by pure solar mass) is started.

Because Sun's magnetic field from $n = 6 \times 6 \times 6 \times 6$ is eclectically very weak and cannot be distinguished from outer system. Therefore, at least the maximum magnetic radius of the Sun is calculated as

$$a_{max} = g[(6 \times 6 \times 6 \times 2) + \frac{1}{2}]a_{\odot}$$

$$= 1(432 + 0.5)0.39Au$$

$$=168.7\text{Au}$$

$a_{maxeff} = 168.7\text{Au} \times 0.832$

$= 140.4\text{Au}$ (Distant to Helio pause) 9-3-1

Because keplerian missing factor for earth observer is $f_k = 1.202$ and gravitational permittivity of air at earth surface $g = 2, x_g = 1.033548$, this distant observed on Earth is

$a_{Earth} = (140.4\text{Au} \times 0.832)(1.033548)$

$= 120.7\text{Au}$ 9-3-2

In the fall of 2013, NASA announced that Voyager 1 had crossed the heliopause as of August 25, 2012.This at a distance of 18 billion km from the Sun was

$a_{Earth} = 121$ AU 9-3-3

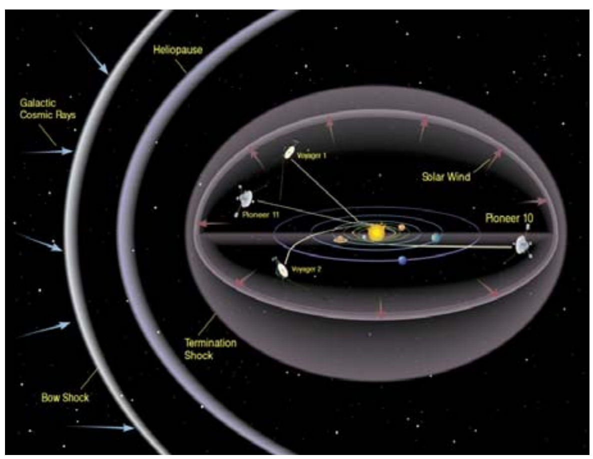


Figure 9-3-1

The energy level of a hydrogen atom is $n = 1$, but the real maximum quantum number by transition is $n = 6$. Therefore, the end of the hydrogen atom is $n = 6$. Outside of $n = 6$, an electron is free from potential. Because the sun corresponds to a huge proton, it can be defined as in the case of the hydrogen atom. As discussed in §8.2, the maximum mass number of a star is $n = 6 \times 6 \times 6 \times 6$. Therefore, the maximum extended radius of the sun can be calculated as

$a_{\max} = g\,(1296 + \frac{1}{2})\, a_{\odot}$

$= 1(1296 + 0.5)\ 0.39\text{Au}$

$=505.6\ \text{Au}$ 9-3-4

Average perturbation rate around $n = 6 \times 6 \times 6 \times 6$ believed by earth force line curve $g = 1.202$ is

$$R_p = \frac{1k}{1.202} = 0.832 \quad 9\text{-}3\text{-}5$$

Rear maximum radius of solar system is

$a_{\max} = (505.6\ \text{Au})(0.832)$

$=420.7\ \text{Au}$

$\approx 400\ Au$ 9-3-6

Only with such definition of the maximum radius of solar system can we have a standard for classifying and distinguishing solar phenomena or other stellar phenomena. Ratio between radius of solar surface and radius of maximum solar energy level agree ratio between radius of cosmic surface and radius of maximum cosmic energy level according to correspondence principle of CFLE theory(cf.§13.15).

9.4. Quantization of the Maximum Planetary Number of the Solar System and Definition for Planets of the Solar System by CFLE Theory

Because the sun corresponds to a hydrogen atom, per the correspondence principle of CFLE theory, the maximum number of planets should be $N = 8$ according to $N = 2n^2$. Because the mass number of the sun is $A=2$ correspond quantum number $\text{n} = 2$, the possible solar quantum number is in fact

$N = 2(n^2)$

$= 2(2\ )^2 = 8$ 9-4-1

Therefore, the sun can have only 8 planets; despite Sun can have 22 gravitational energy levels in its gravitational system. With this new quantum mechanical definition, we can distinguish the planets of the solar system or the planets of another star system and we can fix the controversies by the International Astronomical Union in 2006 over the definition of a planet. That means definition of planet of IAU is correct (Pluto is not planet). Therefore, 8 planets of solar system is Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune.

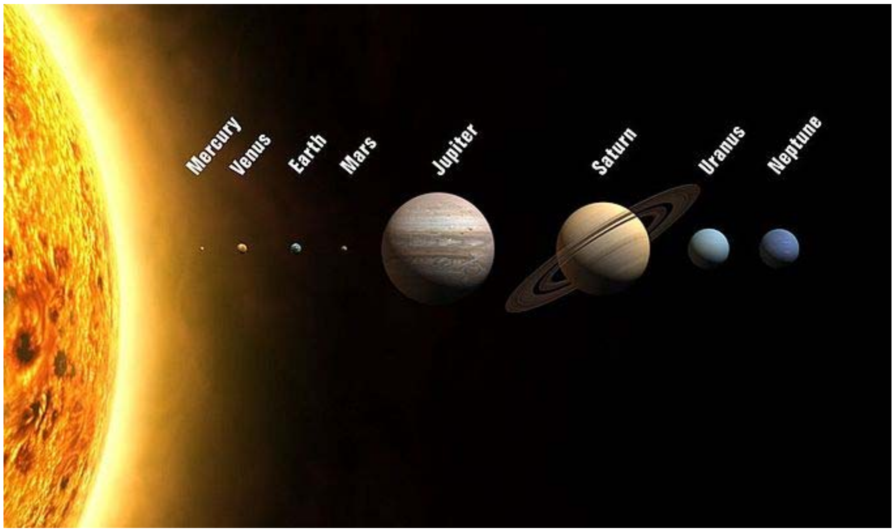


Figure 9-4-1

9.5. Macro Energy Quantum $\hbar_\oplus$ for the Solar System and Justification for Its Use

Because the gravitational force of the solar system corresponds to the electromagnetic force of the atomic system, the macro energy quantum $\hbar_\oplus$ (cf. §7) of the solar system would be

$$\hbar_\oplus = (1.686044 \times 10^{21})^2$$

$$= 2.842744 \times 10^{42} \text{ Js}$$

Therefore, the energy quantum of a solar system is

$$\hbar_\oplus = \frac{2.842744 \times 10^{42} \text{ Js}}{(2)\,(3.141592)}$$

$$= 4.524369 \times 10^{41} \text{ Js} \qquad 9\text{-}5\text{-}1$$

The physical justification of this energy quantum can be confirmed by using the formula

$$\Delta MV\Delta X \leq \hbar_\oplus$$

In this formula, let the mass of Earth be $M_\oplus = 5.976 \times 10^{24}$ kg.

The orbital radius of Earth is $R_\oplus = 1.4598 \times 10^{11}$ m.

The orbital speed is $V = 2.978 \times 10^{4}$ m/s.

The results are

$(5.976 \times 10^{24}\text{ kg})\ (2.978 \times 10^{4}\text{ m/s})\ (1.496 \times 10^{11}\text{ m})\ d = 4.524 \times 10^{41}$ Js

$(2.622 \times 10^{40}\text{ Js})\ d = 4.524 \times 10^{41}$ Js

$17.254\ d = 1$ 9-5-2

This difference is essentially only a factor of (cf. §5,§24)

$d = (\frac{6.545976}{1.5})^2 = 19.044374$

Therefore,

$g = \sqrt{17.254} = 4.154$ 9-5-3

This value should agree with $g = \frac{6.546}{1.5} = 4.363$.

The difference of the two values is

$d = \frac{4.363}{4.154} = 1.050$ 9-5-4

Because the gravitational permittivity with $c_c = 1.5$ is

$Q_g = (0.016774)\ (1.5) = 0.025161$

$x_g = 1.025161$

the gravitational permittivity of this force is

$(x_g)^2 = 1.050955$ 9-5-5

Because the electrical permittivity with $c_c = 1.5$ is

$Q_e = (0.000589)\ (1.5) = 0.000884$

$x_e = 1.000884$

$(x_e)^2 = 1.001769$ 9-5-6

The total permittivity is

$$x_{tot} = \frac{1.050955}{1.001769}$$

$$= 1.049099$$

$$= 1.050 \quad 9\text{-}5\text{-}7$$

This corresponds well with the calculated difference in Eq. 9-4-4, and therefore we can find assurance here that the CFLE theory is correct.