Formation of Extrasolar Systems and Moons of Large planets in Clusters

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Abstract

Two models the membrane model and the equivalent model were used for the solution of some of the questions related to formation of the Solar System. Both models show that the planets create clusters in which lies a higher probability of origination of large masses. The rings and belt of asteroids between Mars and Jupiter and the belt of asteroids behind the Neptune track are the beginnings of these clusters.

According to the equivalent model, the Solar System went through a different development than other extrasolar systems. Both models show the wave principle, which is the same for other planetary systems and systems of moons of large planets [1].

keywords: Solar system:formation, Planets and satellites, Waves, Asteroids

1 Introduction

Formation of the Solar system and its development is well described in the paperwork [2]. The existing theories presume the age of the Solar system as 4.5 billion years and that the entire system was created approximately 100 million years after the formation of the Sun. Despite of this, some of the chronological events of the formation of the systems still remain unknown to us.

By comparing with the young TTauri stars, we can say that the Sun formed in the center of a protoplanetary disc with dimensions of approximately 1000 AU. The planets formed in the first 10 million years after the formation of the protoplanetary disc. The development of the Solar system was terminated approximately 90 million years after the formation of the protoplanetary disc.

However, there are many inexplicable questions. Is our Solar system exceptional? Why there are at least two populations of meteorites of different ages?

Why do planets form in clusters? Which planets formed first and how? Are there any other undiscovered planets in the Solar system? We will try to solve some of the questions using the theoretical models of the origin of the Solar system and by comparing the solar system with the planetary systems. In the first case, we tried to apply the membrane model to the Solar system using the fine structure constant. In the second case, we will compare all the satellite planet systems using the weight of the central object and its distance.

2 Membrane model - theory

Currently, the kinematics and dynamics of the Solar system are described using two methods. The first method is the classic approach [3], which is described using classical physics. This approach comes from the Newton and Einstein Theories. The second approach describes the Solar system using quantum physics, which has been very successful describing the physical events of a micro world.

Very interesting explanation of why we should study star systems using quantum mechanics was brought by the papers [4], [5], [6], [7], [8], [9] and many other authors.

The star system can also be described using a modified Schrődinger equation [7]:

$$\frac{-g^{*2}}{2\mu}(\frac{\partial^2\psi}{\partial r^2}+\frac{1}{r}\frac{\partial\psi}{\partial r}+\frac{1}{r^2}\frac{\partial^2\psi}{\partial\theta^2})+V(r)\psi=E\psi \tag{1}$$

where E is the total energy of the system, $\mu = mM/(m+M)$ is reduced weight and $g^* = 1.2 \times 10^{42}$ Js is the re-scaled Planck constant.

Based on this consideration, we described in [10] the planetary tracks using the modified Schrődinger equation where we have chosen a similar solution system, but we also used statistical methods. We pointed out a very interesting connection in dividing the weight probability of planets in the Solar system.

But how can we explain the discrete tracks of planets around the central objects using classical physics? There is only one way the wave principle. Thus, we need waves which form certain sectors where there is the highest probability to create a large object.

But how can we apply the wave principle to the formation of star systems? Is there a universal principle? This question has been answered in the Science Magazine [12]. The authors presume that the Solar system originated in a large cloud of ionized gas. However, not only the Sun was formed, but also other stars of large and small weights. The basic argument of this theory is the presence of the Fe^{60} isotope in meteors. This isotope is not stable and can be created only in the hearts of very massive stars. The presence of the Fe^{60} isotope in our Solar system is, thus, the main proof that the Sun was created along with very massive stars in an ionized nebula.

Lets consider our Solar system, where we have performed some simplifications:

- The orbits of the orbs around the Sun are considered circular.
- These orbits lay in one plane with regard to the Sun.

Then, we can define a two-dimensional planetary model of radius r_0. Is there a physical explanation of why we define a two-dimensional membrane? There are two possibilities:

- The theory of star formation, according to [11]. Provided the nebula is ionized, the electric fields induce movements of plasma [15]. The plasma allows spreading the waves analogically as waves in a taut string (one dimension case) or as waves in a membrane (two dimension case). The speed of these hydro-magnetic waves v_A is directly proportional to the magnetic induction B field (analogous to the tension in the membrane) and inversely proportional to the square root of the plasma density ρ (analogous to the density of the material from which the membrane was made)

$$v_A = \sqrt{\frac{B^2}{\rho\mu_{med}}}, \tag{2}$$

where ρ is the plasma density and μ_{med} is the environment permeability.

- Another explanation of why we define the membrane model is the possibility that the environment has, in [13] electric and magnetic character. These electric and magnetic characteristics create gravitation. This structure is the source of the dark mass and energy and also the source of gravitation.

To understand the development of the Solar system, lets imagine a circular membrane model (two dimension model) with r_0 radius. Properly, we should apply a three dimension model [14] but a two dimension model is, for our considerations, sufficient. Furthermore, lets presume that the surface of the membrane is flat at the beginning of the development. However, during the development, the membrane surface can change through interactions with external forces (electric fields, shock waves from nearby stars). These influences can be described as small causal deviations, which deform the surface of a two dimensional circular membrane.

It is a perfectly bendable circular membrane of consistent thickness [15]. It is pre-stressed with force F_l in length units acting in distance r_0 from the center of the membrane. When creating the movement equation, we consider only the cross deviations $\omega \equiv \omega(x, y, t)$, which are small in comparison with the dimensions of the circular membrane. If μ_A is a unit weight of the sector and the function $g_A(x, y, t)$ is the operation burdening the unit forces, then the movement equation for these deviations at $\mathcal{B} \times \mathcal{R}^1$ have, in Cartesian coordinates, the following form:

$$\frac{\partial^2 w}{\partial t^2} = \frac{F_l}{\mu_A}\left(\frac{\partial^2 w}{\partial x^2} + \frac{\partial^2 w}{\partial y^2}\right) + \frac{g_A(x, y, t)}{\mu_A} \tag{3}$$

and the initial and limit conditions are:

$$w|_{t=0} = w_0(x, y), \quad \left.\frac{\partial w}{\partial t}\right|_{t=0} = 0, \tag{4}$$

$$w|_S = 0. \tag{5}$$

where β is a disc of radius r_0 and the center of the origin, S is a circle which is a limit of the disc [16]. The relation $\sqrt{\frac{F_l}{\mu_A}} = v$ is speed.

If we institute the polar coordinates r and φ with the relationships $x = r\cos\varphi$ a $y = r\sin\varphi$, we rewrite the equation (3) and the conditions (4), (5) for function $w(r\cos\varphi, r\sin\varphi, t) = \tilde{w}(r, \varphi, t)$ and $g_A(rcos\varphi, rsin\varphi, t) = \tilde{g_A}(r, \phi, t)$:

$$\frac{\mu_A}{F_l}\frac{\partial^2 \tilde{w}}{\partial t^2} = \frac{\partial^2 \tilde{w}}{\partial r^2} + \frac{1}{r}\frac{\partial \tilde{w}}{\partial r} + \frac{1}{r^2}\frac{\partial^2 \tilde{w}}{\partial \varphi^2} + \frac{g_A(r, \varphi, t)}{F_l}. \tag{6}$$

$$\tilde{w}|_{t=0} = \tilde{w}_0(r, \varphi), \quad \left.\frac{\partial \tilde{w}}{\partial t}\right|_{t=0} = 0, \tag{7}$$

$$\tilde{w}|_{r=r_0} = 0. \tag{8}$$

When the weighting force $\tilde{g_A}(r, \phi, t)$, $\tilde{g_A}(r, \phi, t) = 0$, we are solving the homogenous equation

$$\frac{\mu_A}{F_l}\frac{\partial^2 \tilde{w}}{\partial t^2} = \frac{\partial^2 \tilde{w}}{\partial r^2} + \frac{1}{r}\frac{\partial \tilde{w}}{\partial r} + \frac{1}{r^2}\frac{\partial^2 \tilde{w}}{\partial \varphi^2}. \tag{9}$$

The task is solved using the method of separation of variables, which is based on the solution of the form

$$\tilde{w}(r, \varphi, t) = R(r, \varphi)T(t). \tag{10}$$

By substitution (10) into the (6) equation and respecting the conditions (7), (8), we acquire the solution

$$\frac{d^2}{dt^2}T(t) = -\lambda^2\frac{F_l}{\mu_A}T(t) \tag{11}$$

and marginal value problem

$$\left(\frac{\partial^2}{\partial r^2}+\frac{1}{r}\frac{\partial}{\partial r}+\frac{1}{r^2}\frac{\partial^2}{\partial\varphi^2}\right)R(r,\varphi) = -\lambda^2 R(r,\varphi), \tag{12}$$

$$R(r,\varphi)|_{r=r_0} = 0, \tag{13}$$

where λ is an unknown constant. We are solving a marginal-value problem (12)–(13) using separation of variables

$$R(r,\varphi)=R_1(r)\Phi(\varphi), \tag{14}$$

which, by substitution of (14) into (12) and (13), carries the marginal-value problem

$$\left(r^2\frac{d^2}{dr^2}+r\frac{d}{dr}+(\lambda^2r^2-\nu^2)\right)R_1(r) = 0, \tag{15}$$

$$R_1(r)|_{r=r_0} = 0, \tag{16}$$

and a common differential equation

$$\Phi''(\varphi)+\nu^2\Phi(\varphi)=0, \tag{17}$$

where ν an unknown constant. By transfer into polar coordinates, we must fulfill some of the conditions

$$|R_1(r)|_{r=0}| \leq \infty, \tag{18}$$

$$\Phi(\varphi) = \Phi(\varphi+2\pi). \tag{19}$$

2π periodical solution of equation (17) exists for $\nu=n$

$$\Phi_n(\varphi)=A_n\cos(n\varphi)+B_n\sin(n\varphi). \tag{20}$$

because, for $\nu=-n$, we get the solution of the same form, we will limit ourselves to $n\geq 0$. The equation (15) is a differential equation for function $J_\nu(\lambda r)$ level ν and Neumann function $N_\nu(\lambda r)$ level ν and general solution is, for $\nu=n$ in the following form:

$$R_{1n}(r)=C_nJ_n(\lambda r)+D_nN_n(\lambda r). \tag{21}$$

If the function $N_n(0)$ is unlimited, then, $D_n=0$ is the result. The limit conditions (16) are presumed as:

$$C_nJ_n(\lambda r_0)=0. \tag{22}$$

The (22) equation has the solution $\lambda=0$ for $n\neq 0$ and solution

$$\lambda_m^{(n)}=\pm\frac{\mu_m^{(n)}}{r_0},\quad n=0,1,\ldots,\infty,\quad m=1,2,\ldots,\infty, \tag{23}$$

where $\mu_m^{(n)}$ are positive roots of the equation

$$J_n(\mu)=0. \tag{24}$$

The solution of the marginal-value problem (15)–(16):

$$R_{1nm}(r)=C_nJ_n\left(\mu_m^{(n)}\frac{r}{r_0}\right), \tag{25}$$

where $\lambda_m^{(n)}\geq 0$. The problem solution (11) is:

$$T_{nm}(t)=E_{nm}\exp(i\Omega_{nm}t), \tag{26}$$

where

$$\Omega_{nm} = \lambda_m^{(n)} \sqrt{\frac{F_l}{\mu_A}}. \tag{27}$$

The solution of the mixed problem (9)–(8) with separated variables, can be rewritten

$$\tilde{w}_{nm}(r,\varphi,t) = R_{1nm}(r)\Phi_n(\varphi)T_{nm}(t), \quad n = 0,1,\dots,\infty, \quad m = 1,2,\dots,\infty. \tag{28}$$

The solution of the marginal-value problem (9)–(8) is:

$$\tilde{w}(r,\varphi,t) = \sum_{n=0}^{\infty}\sum_{m=1}^{\infty} \tilde{w}_{nm}(r,\varphi,t)$$

$$= \sum_{n=0}^{\infty}\sum_{m=1}^{\infty} \{[A_{nm}\cos(\Omega_{nm}t) + B_{nm}\sin(\Omega_{nm}t)]\cos(n\varphi)$$

$$+[C_{nm}\cos(\Omega_{nm}t) + D_{nm}\sin(\Omega_{nm}t)]\sin(n\varphi)\} J_n\left(\mu_m^{(n)}\frac{r}{r_0}\right). \tag{29}$$

The solution of the mixed problem (9)–(8)–(7) is:

$$\tilde{w}(r,\varphi,t) = \sum_{n=0}^{\infty}\sum_{m=1}^{\infty} \cos(\Omega_{nm}t)[A_{nm}\cos(n\varphi) + C_{nm}\sin(n\varphi)] J_n\left(\mu_m^{(n)}\frac{r}{r_0}\right), \tag{30}$$

where

$$A_{nm} = \frac{2}{\pi(\delta_{n,-n}+1)r_0^2 J_{n+1}^2\left(\mu_m^{(n)}\right)} \int_0^{2\pi}\int_0^{r_0} r\cos(n\varphi) J_n\left(\mu_m^{(n)}\frac{r}{r_0}\right)\tilde{w}_0(r,\varphi)\,dr\,d\varphi, \tag{31}$$

$$C_{nm} = \frac{2}{\pi(\delta_{n,-n}+1)r_0^2 J_{n+1}^2\left(\mu_m^{(n)}\right)} \int_0^{2\pi}\int_0^{r_0} r\sin(n\varphi) J_n\left(\mu_m^{(n)}\frac{r}{r_0}\right)\tilde{w}_0(r,\varphi)\,dr\,d\varphi. \tag{32}$$

After selecting

$$\tilde{w}_0(r,\varphi) = J_{n_0}\left(\mu_1^{(n_0)}\frac{r}{r_0}\right)\sin(n_0\varphi) \tag{33}$$

it is true that

$$A_{nm} = 0, \quad C_{nm} = \delta_{n,n_0}\delta_{m,1}. \tag{34}$$

The (30) solution is valid for any circular membrane. For $n = 0$ membrane has non zero amplitude at the point $r_0 = 0$. For other n, $J_n(0) = 0$. The n and m indexes describe the position of nodal lines. The membrane has $2n$ radial nodal segments and m nodal circles including the perimeter of the membrane.

3 Membrane model - application to star systems

We define the center of the membrane model as the point from which we spread the waves to other sectors of the membrane. The membrane center must not, therefore, be defined solely with one point, but by a sector which is equal to the half of the Schwarzschild gravitational radius:

$$r_{Schwarz} = \frac{GM^{Star}}{c^2}, \tag{35}$$

where G is the gravitational constant, M^{Star} is the weight of the central star and c is the speed of light.

Pursuant to the vibrations of the membrane model, we can define sectors of high probability of formation of planets and moons and sectors with low probability of forming objects in the Solar system. The distances between the smallest probabilities of origination of an orb are called waves. The following applies for the distances with the smallest probability of forming an orb:

$$r_{mem} = r_{Schwarz}(\mu_m^n)^8, \tag{36}$$

where μ_m^n is the position of a nodal point of the Bessel function.

Based on the equation (3), we describe the distances of waves for planets using the Bessel function J_0, and distances of waves for moons around large planets using the Bessel function J_1. We interpret the Bessel waves J_0 a J_1 as oscillation of material in electric and magnetic fields of the membrane model.

Well now discuss the exponents of the nodal points for the radius of the membrane model. According to the relationship between the electrical F_{elec} and gravitational F_{grav} forces, the following applies:

$$\alpha_e \frac{F_{grav}}{F_{elec}} = \alpha_g, \tag{37}$$

where $\alpha_e = 1/137$ is the constant of fine structure and $1/\alpha_g = 2113 \pm 15$ is the structural gravitational constant pursuant to [4]. The following applies for the ratio between the electrical and gravitational forces:

$$\frac{F_{elec}}{F_{grav}} = \frac{\alpha_e}{\alpha_g} = 15.4 \tag{38}$$

This value lies between the first wave of the hot-Jupiter planets and the second wave, because the gravitational structural constant from [4] depends on the first orbit of the planet (hot-Jupiter) around the central orb. According to the value 15.4 between the waves, we found only two possible solutions for $[\mu_m^{(n)}]^8$ and $[\mu_m^{(n)}]^9$. Provided we apply the solution of the exponent value $[\mu_m^{(n)}]^9$, we do not get a good harmony with the observation. The only possible solution is, therefore, the exponent value $[\mu_m^{(n)}]^8$.

$$r_{mem} = r_{Schwarz}[(\mu_m^n)^4]^2 \tag{39}$$

and substitution $[\mu_m^{(n)}]^4 = [\nu_m^{(n)}]$ in the form

$$r_{mem} = r_{Schwarz}[(\nu_m^n)^2]. \tag{40}$$

The (40) is very similar to the equation for orbits of hydrogen atoms, but the physical interpretation is different.

- The ν_m^n values are not quantum numbers of orbits, but nodal points of the Bessel waves. The nodal points can be interpreted as the smallest probability of forming planets around stars. Because the Bessel waves are symmetric, we are also able to interpret the highest probability of forming planets around central stars.
- We do not interpret the half Schwarzschild radius as the first orbit of a planet, we understand it as a center of the membrane model, wherefrom the waves spread into other sectors.

According to this interpretation, we can understand this model as a gravitational atom.

4 Systems of Isolated Stars

For the smallest probability of formation of planets around isolated stars applies:

$$r_{mem} = \frac{GM^{Star}}{c^2}(\mu_m^0)^8. \tag{41}$$

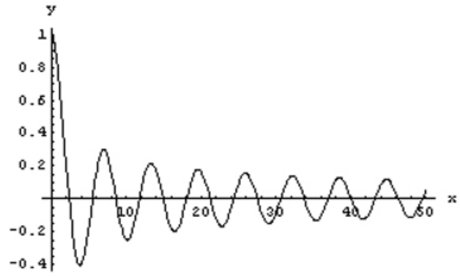

Figure 1: Bessel function $J_0(x)$.

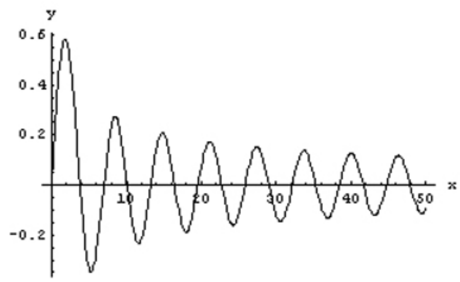

Figure 2: Bessel function $J_1(x)$.

Important orbits referring to the nodal points μ_m^0 determine the temporary sectors of the planetary system, where the large orbs (planets) have the smallest probability of origination. There are only small orbs. These orbits are radii of the membrane model in our paper. The possible origination of planets around the isolated planets takes place only in certain areas. These areas are called waves. We describe the creation of the planets around the isolated stars as vibrations of monopoles of the membrane model.

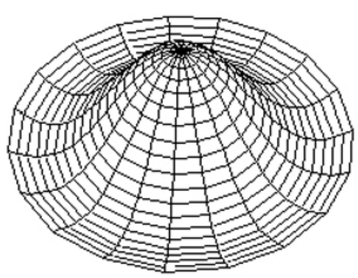

Figure 3: Course of the Bessel waves J_0 in the membrane model.

5 Systems of Moons around Large Planets

Lets imagine a two-star system or a system of moons around large planets. The central planet M_p and the central star M^{Star} must have influence on the formation of moons around the large planets but also the distance between the central star and the central planet l, in which the moons circulate. The problem of two weights is solved using the Newton potential

$$\Phi = G(\frac{M^{Star}}{R_1} + \frac{M_p}{R_2}), \tag{42}$$

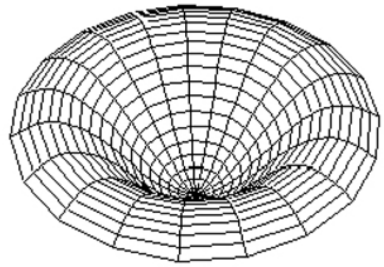

Figure 4: Course of the Bessel waves J_0 in the membrane model.

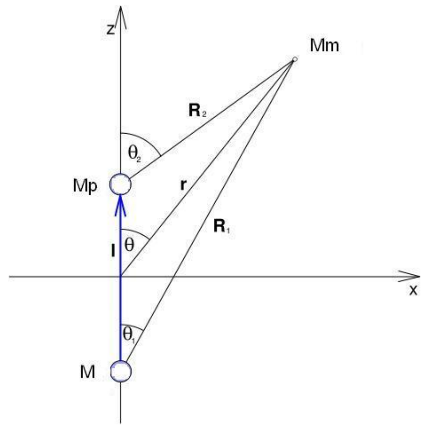

Figure 5: Problem of two orbs.

where R_1 is the distance between the central star and moon, R_2 R2 is the distance between the central planet and moon, l is the distance between the central star and the central planet.

According to equation (42) we can define the distance $r_{Schwarz}$ under the condition $l \approx R_1$

$$r_{Schwarz} = \frac{GM^{planet}}{c^2}, \tag{43}$$

where $r_{Schwarz}$ is half Schwarzschild radius of the planet. The membrane model depends on the weight of the central star. We define the center of the membrane model for the system of moons as follows:

$$r_{centre} = \frac{GM_\mu}{c^2}, \tag{44}$$

where M_μ is the reduced weight of the membrane model for moon system

$$M_\mu = \sqrt{\frac{M_{Star}^2 M_p}{M^{Star} + M_p}}. \tag{45}$$

Thus, for the smallest probability of formation of moons around large planets applies:

$$r_{mem} = r_{centre}(\mu_m^1)^8. \tag{46}$$

Provided we study the development of the Solar system, the Solar system has a different development than extrasolar systems with similar weights of the central stars. This is based on data from space probes and research of extrasolar systems. If we compare the known extrasolar systems to our Sun, the Hot Jupiter planets are missing in our system (9).

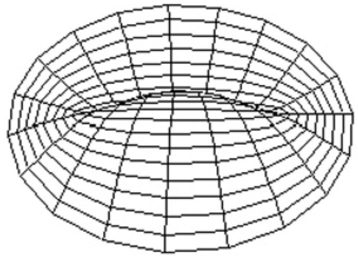

Figure 6: Course of the Bessel waves J_1 in the membrane model.

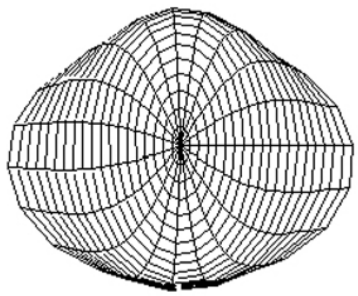

Figure 7: Course of the Bessel waves J_1 in the membrane model.

6 Equivalent model - theory

The equivalent model is based on equations which might be comparable in both spaces in reality and in the model. The equivalent model can use artificial or natural models. In case of our Solar system, the satellite sets of planets can be used as the model of the entire Solar system (or vice versa) and both of these models can be used as a model of extrasolar systems (and vice versa). The same physical laws must apply in both spaces real and model. We must use such relations and standardization during the equivalent planning, so all modeled parameters are equivalent. In our case, we will not use the most difficult parameter to model time. We will limit ourselves to only two parameters distance and weight. We will use Newtons law of gravitation

$$F_{grav} = \frac{GM_pM^{Star}}{r^2}, \tag{47}$$

where G is the gravitational constant, M^{Star} is the weight of the central orb, M_p is the weight of the planet and r is the distance between both orbs. If we divide both sides of the equation twice by the central weight M^{Star}, we will get its equivalent representation in the Newton gravitational model

$$\underbrace{\frac{F_{grav}}{M^{Star}}}_{\hat{F}} = G\underbrace{(\frac{M_p}{M^{Star}})}_{\hat{M}_p}\underbrace{(\frac{M^{Star}}{M^{Star}})}_{=1}\underbrace{(\frac{M^{Star}}{r^2})}_{\frac{1}{r^2}}, \tag{48}$$

where the equivalent central weight M^{Star} is standardized to 1. The equation shows that the equivalent gravitational force is $\hat{F} = (F_{grav}/M^{Star})$, equivalent periphery weight is $\hat{M}_p =$

(M_p/M^{Star}) and the equivalent distance is $\hat{r} = (r/\sqrt{(M^{Star})}$.

7 Ekvivalent Model - Application to a Solar System

During the last decades, many probes were exploring the majority of the planets in the Solar system including Uranus and Neptune. The Voyager 2 probe brought the majority of information on the moons of Jupiter (1979), Saturn (1981), Uranus (1986) and Neptune (1989) (Voyager page JPL 2006). Therefore, nowadays we know almost the complete system of planet satellites with radius larger than 2050 km. This forms a good database for comparison analysis.

Mars has two moons Phobos and Deimos which are probably caught asteroids and, thus, neither the first orbit nor their position may not serve for comparison with the genesis of satellite systems. The first four of Jupiters moons were discovered by Galileo Galilei in 1610. Nowadays, we know of 67 satellites of Jupiter with the smallest diameter $1-2$ km. Only in 2003, S. Sheppard and D. Jewitt discovered 21 new satellites from the observatory in Hawaii.

The dependence of their distribution in distance from Jupiter is shown in figure no. 8. The weight distribution forms an almost lognormal distribution with the maximum of masses around a distance of 1 million kilometers. Quite evident are two belts of satellites of distances 15.5 and 21.2 million kilometers from Jupiter. The diameters of the orbits form almost an exponential series and, thus, are almost equidistant in a logarithmic scale with one exception between the last large moon Callisto and two belts of satellites on the periphery of the satellite system. At first sight, the satellite system of Saturn is different from the satellite systems of the other planets due to its rings, but the weight distribution is very similar to other planets and, in addition, small rings were discovered around all the large planets [18], [19]. The Saturn rings mark the belts of the satellites on the planet side and also in the minimum of the weight distribution in the orbit node close to the Iapetus moon in distance 480000 km. The weight distribution of the Uranus satellites is very similar to the mass distribution around Jupiter with such characteristics as the lognormal distribution, gap in weight distribution behind the largest moons, ring of satellites at the system periphery and exponential distribution of the satellite orbits. The transition of the character of the mass distribution from large moons towards Uranus is very pronounced. The orbits with large mass concentration (large moons) merge into orbits on which are only smaller satellites and those in the vicinity of Uranus transfer into rings in which reside only small objects (stone and dust).

The mass distribution around Neptune is not as pronounced as the distribution around Uranus, but shows the same basic characteristics. If we compare all the satellite planet systems and Solar systems in an equivalent scheme by standardizing the central weight = 1 (dividing the set in the equivalent scheme by weight, or more precisely by dividing the distance by the square root of the central weight) (see fig. 8), we can see that all the satellite systems, with exception of the Solar system, as an entity, copy one and the other. The Solar system does not conform to the other systems neither in the weight nor distance scale. If, theoretically, we increase the weight of the Sun 12 to 15 fold, the weight distribution of the Solar system would be comparable to all other satellite planet systems (see fig. 8). Then we can see that the mass creates concentrated clusters of planets and moons. The probability function of the weight distribution would then be described as a decreasing wave function with lognormal distribution of the mass in the clusters. The first cluster then corresponds to the standardized radius of the central orb. The second cluster corresponds to the terrestrial planets or to the largest moons of planets. The third cluster corresponds to large gaseous giant planets and/or periphery planet satellites. If we extrapolate, in the same sense, the probability distribution function from the Sun, then we could presume the existence of another cluster of concentration of mass into planets similar to moons with weight approx. 10^{-7} of the Sun weight, in distances $10^{-5} kmkg^{-1/2}$ of the square root of the Sun weight.

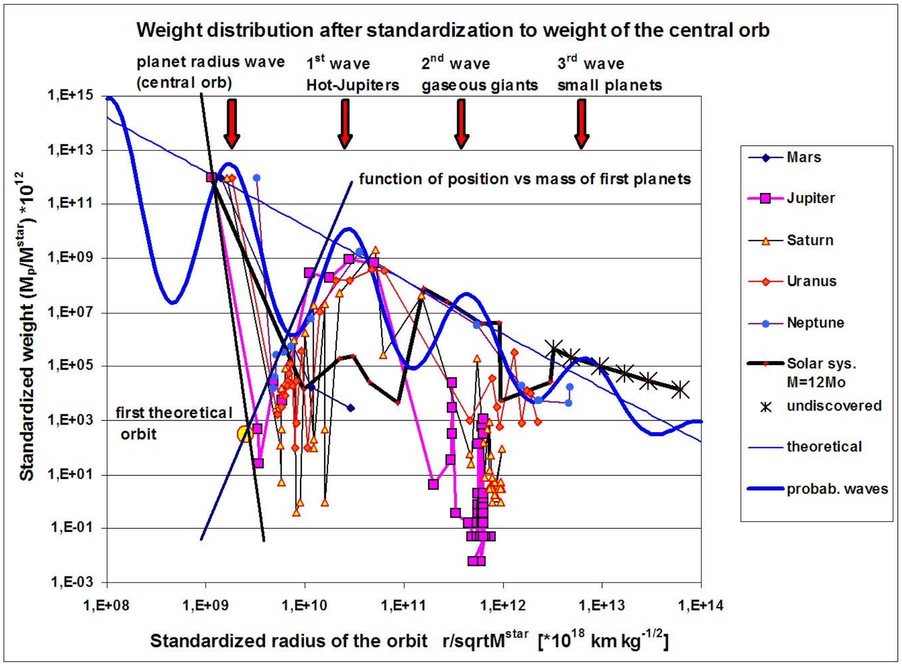

Figure 8: Weight distribution standardized by the weight of the central orb.

7.1 Application of the Equivalent Model to Extrasolar Systems

If we carry the dependence of the orbit radius on the weight of the central orb, we can see that the radius of the first orbit of the extrasolar planets and moons in the Solar system can be described as a line in the log-log scale (see fig. 9). The directive of this line is approx. 0.5 in concordance with the theory (see chapter 7). The extrasolar planets form two clusters. The first cluster, closer to the central star, is formed by hot-Jupiter planets with orbit periods of several days. The external cluster of planets is formed by large gaseous giants with orbit period from several years to several decades of years. The more distant planets have not been found yet due to the influence of other orbital periods and smaller gravitation influence on the central star. Figure 9 shows that the first cluster of the Hot-Jupiter type planets is located in equivalent distance from the central orb as well as the largest moons of the planets in the Solar system. The second cluster of the giant, extrasolar planets is located in equivalent distance as small moons at the periphery of the planet satellite systems. On the other side, the Solar system, as a unit, is not comparable to either the extrasolar systems or the satellite planet systems. The radii of the planet orbits in the Solar system are larger than equivalent, which might mean that the Solar system is missing the Hot-Jupiter planet types, or that the Sun weight has been reduced. If we presume that the Sun weight dropped during the genesis of the Solar system $12 - 15$ times, than the terrestrial planets would correspond with their orbits to the orbits of the extrasolar, Hot-Jupiter type planets and the large gaseous giants would correspond to the extrasolar large gaseous giants. We arrived at the same conclusion by comparing the Solar system as a unit to the satellite planet systems (see chapter 8).

Figure (9) shows that, in places where the orbits with a small probability of mass concentration are located, rings (in case of planets) or asteroid belts (in case of the Solar system as in between mars and Jupiter or behind the orbit of Neptune Kuiper belt) are found.

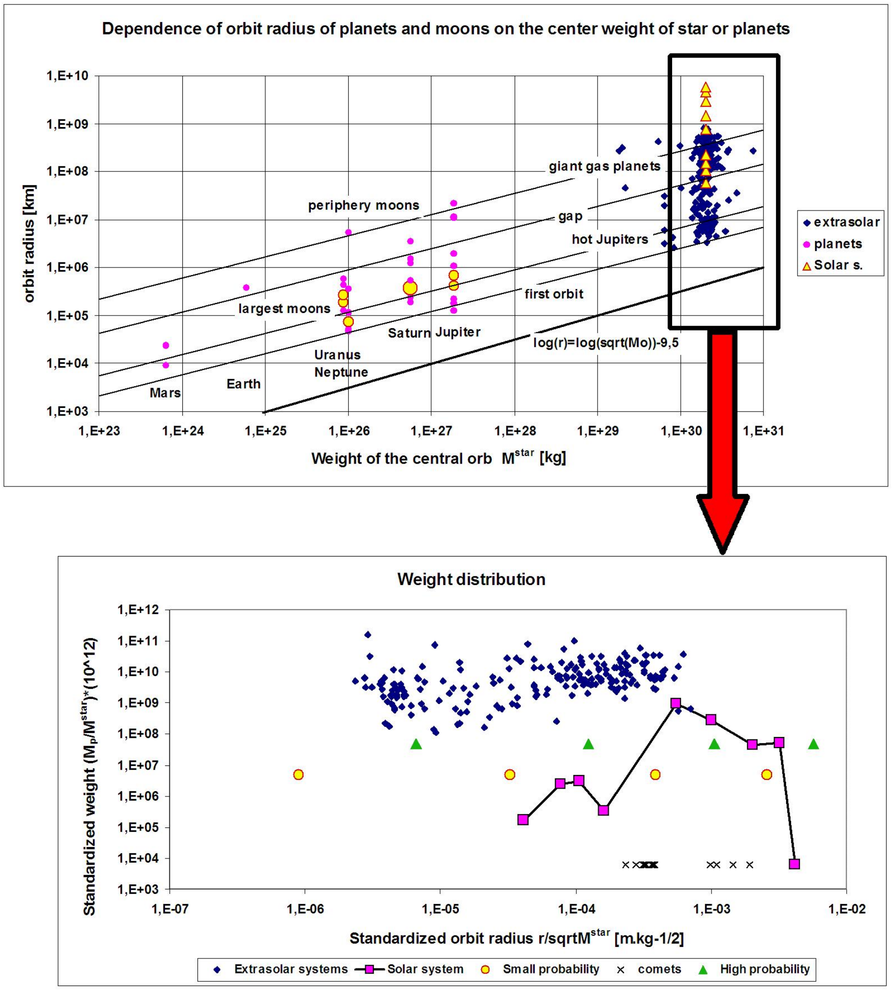

Figure 9: The dependence of the orbits of planet and moons on the central weight of stars or planets and separation of systems in clusters. According to the theory of the membrane model, we presume a low-probability and high-probability concentration of masses.

7.2 Discussion

Both models - the membrane model as well as the Equivalent model - showed that the distribution of mass around the central orb is not monotonously dropping, but forms clusters of discrete orbits with higher probability of concentration. This probability can be described using Bessel functions (see figure 7) which form rings around the central orb, thus a membrane with higher and lower probability than the medium probability. The amplitude of the probability is dropping with distance from the central orb.

The satellite planet systems in the solar system as well as extrasolar planets show the same characteristics of clusters of moons or planets in compliance with the membrane model. The size of the first orbit is comparable as well as the maximum of concentration of the mass in the first and the second cluster. Orbits with small concentration of mass or only with asteroid belts are located between both clusters. From this comparison, it is clear that the largest planet moons are equivalents to Hot-Jupiters and the small periphery moons of planets are equivalents to extrasolar large gaseous giants.

The Solar system shows somehow different behavior in comparison to both other systems. The radius of the first orbit (Mercury) is too distant from the Sun to account for the fact that the terrestrial planets could be a clear equivalent of the Hot-Jupiters. The cluster of terrestrial planets is at distances almost corresponding to the extrasolar large gaseous giants.

However, the large gaseous giants would then not have, in the Solar system, their equivalent in large gaseous giants of extrasolar planets. If we presume that the Sun weight dropped during the genesis of the Solar system $12 - 15$ times, than the terrestrial planets would correspond with their orbits to the orbits of the extrasolar, Hot-Jupiter type planets and the large gaseous giants would correspond to the extrasolar large gaseous giants. We arrived at the same conclusion by comparing the Solar system as a unit to the satellite planet systems (see chapter 8).

7.3 Conclusion

The Solar system is somewhat different from the satellite systems of planetary moons as well as from extrasolar systems. It shows that the Solar system went through a different development than the majority of extrasolar systems. This different development could have caused the possible origin of life on our planet.

7.4 Acknowledgement

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