General introduction for posters 623, 624, 625, 626, 627. There are two classes of the quantum gravitational effects in the gravitation of big bodies.

The first class consists of the quantum gravitational effects which are determined by the quantum gravitational constant H = 145.5 km/s and the sequences of $1/n(n + 1)$, $1/n^2$, n^2, $n(n + 1)$.

The second class consists of the quantum gravitational effects which are determined by the sequence of n and different quantization steps for the different parameters of single and double stars. Each of the latter consists of two very close stars.

The quantum gravitational effects of the first and second classes are investigated in posters 623 and 624, 625, 626, 627, respectively.

Quantum gravitational effects in rotation and size of big bodies

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Part 1. General form of wave equation of a planet.

The first step. Let's write down the time-independent Schrödinger wave equation for any planet of any planetary system and Newton gravitation

$$- (h/2\pi)^2\Delta\psi/2m – (GMm/r)\psi = E\psi,$$

where ψ is the wave function of a planet with mass m and the energy of E. Moreover, r is the distance of the planet to its star with mass M. It is accepted that $M >> m$, which is true for any planetary system.

The second step. Let's divide the left and right sides of the Schrödinger equation by m

$$- (h/2\pi m)^2\Delta\psi/2 – (GM/r)\psi = \varepsilon\psi,$$

where $\varepsilon = E/m$ is the specific energy of the planet.

Why should we do it? Planets have the masses of the different orders of magnitude. For example, the mass difference between Mercury and Jupiter is four orders of magnitude. Therefore, the energy per unit planet mass should be quantized.

The third step. Let's make the transition from the coordinates (x, y, z) to the reduced coordinates ($x' = x/GM$, $y' = y/GM$, $z' = z/GM$)

$$- (h/2\pi GMm)^2\Delta'\psi/2 – (1/ r')\psi = \varepsilon\psi,$$

where $r' = r/GM$.

Why should we do it? The sought wave equation must be obtained in general form.

The fourth step.

Then let's make transition from $h/2\pi GMm$ to $1/H$ where H is the quantum gravitational constant.

Why should we do it? The Planck constant should be replaced by the constant H.

As a result, the general form of the time-independent wave equation for any planet of any planetary system is

$$–\Delta'\psi/2H^2 – (1/r')\psi = \varepsilon\,\psi \qquad (1)$$

From this general form

$$\varepsilon_n = – H^2/2n^2,\ r_n/GM = n^2/H^2 \qquad (2)$$

Part 2. Quantum gravitational constant *H*.

The quantum gravitational constant should be determined from the structure of the Solar System.

Why should we do it? The parameters of the solar planet orbits are determined with high accuracy.

The first step. The eccentricities of the solar planet orbits are close to zero (~ 0.001 – 0.01) with the exception of Mercury. Hence, for such planets, the semi-major axis of orbit a is determined by the solution of (1).

The second step. Let's establish that in any planetary system energy levels can be filled inconsistently and not from the first level.

The third step: Let's suggested that the nearest terrestrial planets consistently occupy neighboring energy levels.

Why should we do it? According table 1 for the nearest terrestrial planets the difference between a is the order of magnitude less than the nearest giant planets.

Using these steps and the least squares method, it is obtained that H is 145.5 km/s.

According table 1 the average difference between the calculated and empirical values of a is 3% with the maximum value of 7% for Venus. According table 1 equations (1, 2) are valid when $Gm/n^2 \geq$ 1190 km^3/s^2. For the moon, Gm/n^2 is only 0.24 km^3/s^2.

Table 1. The parameters of solar planets [1] and the calculated results for these planets.

Planet	Gm, 10^3 km^3/s^2	a, a.u.	n	r_n, a.u.	$\Delta r/a$,[1] %	$\Delta r/\Delta r_\pm$,[2] %	Gm/n^2, 10^3 km^3/s^2
Mercury	22.03	0.387	3	0.377	- 2.6	3	3
Venus	324.9	0.723	4	0.670	- 7.3	14	20.3
Earth	398.6	1.000	5	1.048	4.8	13	15.9
Mars	42.83	1.524	6	1.508	- 1.0	3	1.19
Jupiter	126700	5.203	11	5.070	- 2.6	14	1050
Saturn	37930	9.537	15	9.428	- 1.1	8	169
Uranus	5794	19.19	21	18.48	- 3.7	39	13.1
Neptune	6835	30.07	27	30.55	1.6	22	9.38
Pluto	0.8261	39.48	31	40.27	2.0	31	0.0009

1) $\Delta r = r_n - a$;

2) if $\Delta r < 0$, $\Delta r_\pm = r_n - r_{n-1}$, if $\Delta r > 0$, $\Delta r_\pm = r_{n+1} - r_n$;

Part 3. Quantum hard rotator.

From (1) for the quantum hard rotator

$- \Delta'\psi/2H^2 = \varepsilon\,\psi$,

From this equation

$V_n^2 = n(n + 1)H^2$, $n = 1, 2, \ldots$

Figure 1 shows the distribution of the detached double-lined eclipsing systems (DDLESes). Each DDLES consists of two very close stars, which are the first and second components. The coordinate axis is the second power of the relative orbital velocity of the first and second components (V^2). The distribution is constructed, using empirical data [2].

Two peaks are visible about the quantum values of H^2 and $2H^2$. Hence

$V_n^2 = n^2H^2$, $n = 1, 2, \ldots$

Thus, DDLESes rotate like the quantum hard rotator.

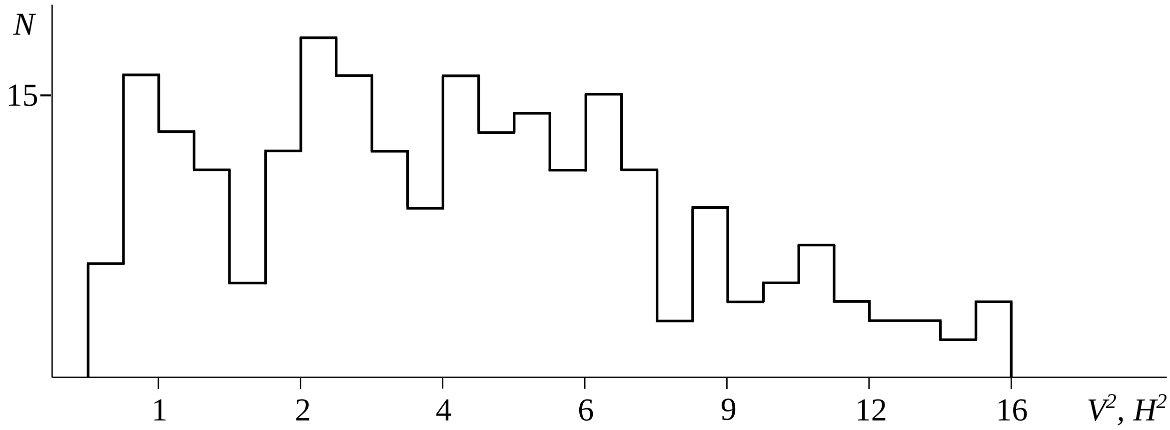

Figure1. The distribution of 254 detached double-lined eclipsing systems.

Figure 2 shows the distribution of the spiral galaxies. The coordinate axis is the second power of the "plateau" orbital velocity of spiral galaxy stars (V_∞^2). The distribution is constructed, using empirical data [3].

Three peaks are visible about the quantum values of $H^2/2$, H^2 and $2H^2$. Empirical data [4] and [5 – 8], respectively, for 304 and 536 other spiral galaxies confirm the validity of this distribution. Note that the galaxies of samples [3], [4] and [5 – 8] are located in different parts of the sky. According to [9, 10] for 2967 spiral galaxies there are peaks about the quantum values of $H^2/9$, $H^2/4$, $H^2/2$ and H^2. Hence

$$V_n^2 = H^2/n(n + 1),\ H^2/n^2,\ n = 1, 2, \ldots$$

Thus, spiral galaxies rotate also like the quantum hard rotator.

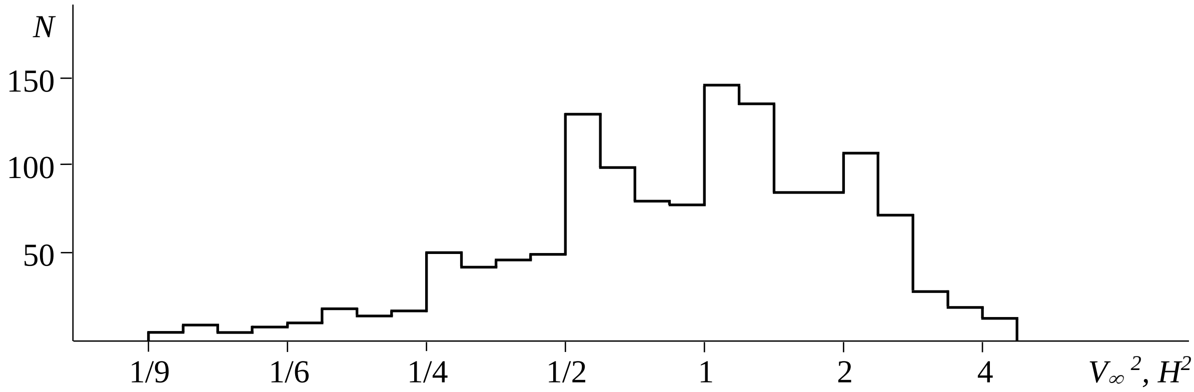

Figure 2. The distribution of 1355 spiral galaxies.

Part 4. Size of big body.

For Jupiter and the Sun, their reduced radius R/GM is the quantum value of $12/H^2$ and $1/9H^2$ with the error of 0.4% and 0.08%, respectively. These results follow from empirical data [1].

In this regard, it is proposed that if the mass of any big body increases the latter is compressed so that R/GM decreases stepwise, taking quantum values

$$R/GM = 1/g_n H^2,\ g_n = n(n + 1),\ n^2,\ 1/n^2,\ 1/n(n + 1);\ n = 1, 2, \ldots \quad (3)$$

The lower boundary of the validity of (3) is determined by Jupiter and Saturn.

For stars, the validity of (3) depends on the energy release of star nucleosynthesis.

The existence of (3) in explicit form is found for stars less than 1.55 solar masses. There is a decrease in the energy release of star nucleosynthesis.

The existence of (3) in more explicit form is found for stars more than 14.10 solar masses. There are qualitative and quantitative changes in the self-gravitation of the supermassive star.

Figure 3 shows the distribution of the single evolving supermassive stars. The coordinate axis is the reduced surface gravitational potential. The distribution is constructed, using empirical data [11, 12].

Two peaks are visible at the quantum values. The peaks are created by the populated areas of the temporal slowdown of the absolute evolutionary expansion of the supermassive star.

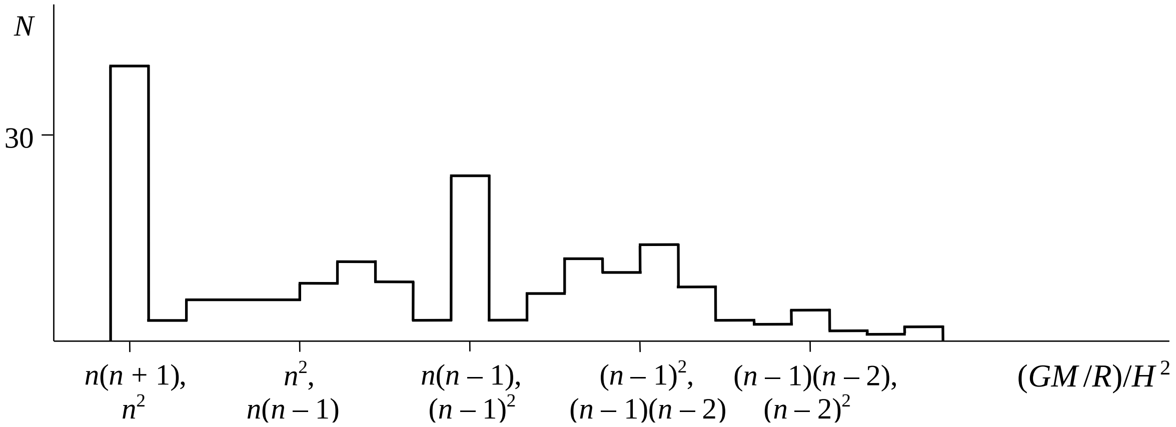

Figure 3. The distribution of 187 single evolving supermassive stars.

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