Probability as a Factor for the Stable Planetary and Electronic Orbits to Exist

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Abstract: *An explanation is proposed that probabilistic factors cause the existence of the stable planetary and electronic orbits. It is confirmed by means of construction of the frequency distributions corresponding to virials.*

Why there are the stable planetary and electronic orbits, and how are they formed? This is all the more puzzle so the centrifugal and gravitational (or electrostatic) forces have different dependence on the distance that leads only to *an unstable equilibrium*. Sure, there are some hidden factors, it may be probabilistic ones.

As an example, one considers the distribution of the orbits in the Bohr's atom planetary model and in the solar system. It is known the orbital radii of the electron in the Bohr's atom to be proportional to the squares of integers. Though the existence of the orbits, i.e. the certain electronic levels, is due to quantum laws, however, this fact can also be explained by probabilistic factors.

According to the Bohr's model and proceeding from the balance of the Coulomb's and centrifugal forces, the orbital radii of the electron are in the simplest case proportional to expression $(z/v)^2$, where z can be considered the geometric mean value between the number of the elementary charges of a nucleus and electrons interacting with each other, and v is the orbital velocity of the electron in some dimensionless units.

Let z and v can take arbitrary values, for example, from 1 to 100. Then the frequency distribution* of the function $(z/v)^2$ has the form shown in Fig. 1.

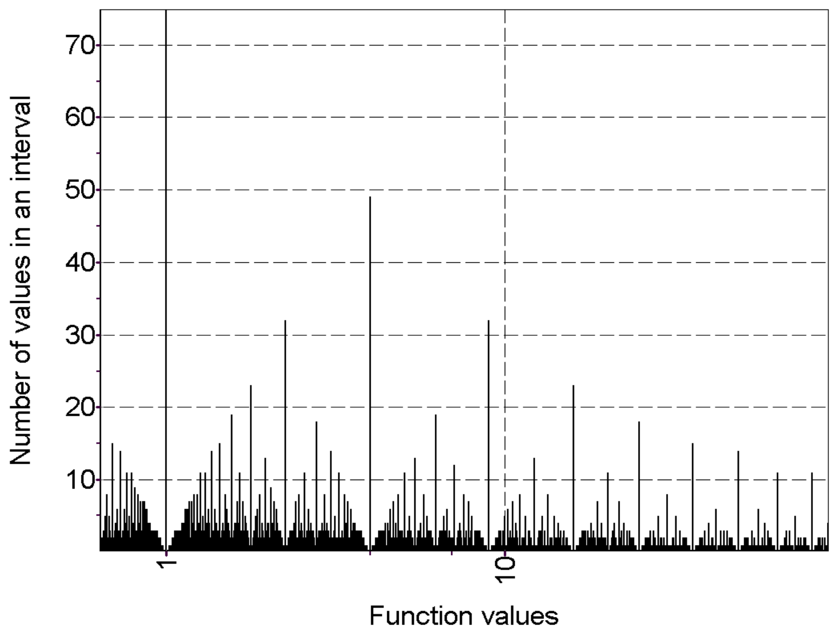

Fig. 1: Frequency distribution obtained with number of the numerical values in the scale 9,800 (of those, nonzero intervals are 3,300).

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*Frequency distributions provide a possibility for bonding the probability of the appearance of numerical values of a function in the area where it exists. That is, the frequency distributions show the reproducibility of numerical values of the function due to allowed varying its arguments. There is a ready-to-use function "frequency" in MS Excel; any other software can be applied as well.

One can see that the peaks of the first order along the *Y*-axis (i.e. the most probable value) have next in values of the function $(z/v)^2$ along the *X*-axis: 1, 4, 9, 16, etc., that is, the orbital radii in the Bohr' atom are proportional to the squares of integers, i.e. to the squares of electronic orbit numbers. Such distributions (or quadratic parts thereof) were also found in others, more complex cases.

Let one considers the distribution of the planetary orbits in the solar system. Their stability can to some extent be explained by orbital resonance, but it is certainly not enough. As for the well-known formula Titius-Bode, it does not follow from any of laws.

The equation relating the orbital radius of a planet R_0, its orbital velocity v_0 and the mass M of a central body is:

$$R_0 = \gamma M / v_0^2, \quad (1)$$

where γ – is the gravitational constant.

In this case it seems the frequency distribution for the orbit positions can not be built because the function has only one variable argument v_0, while others are permanent. However, one can assume that during formation of the solar system the mass of the central body had not been equivalent to a point having a mass equal to the mass of the Sun, and others disturbing factors could had been.

Therefore one can introduce a varied factor j in the formula and write (1) as:

$$R = j / v^2, \quad (2)$$

where R – radius of the planetary orbit in the astronomical units (a.u.), v – the orbital velocity in the units of the orbital velocity of the Earth.

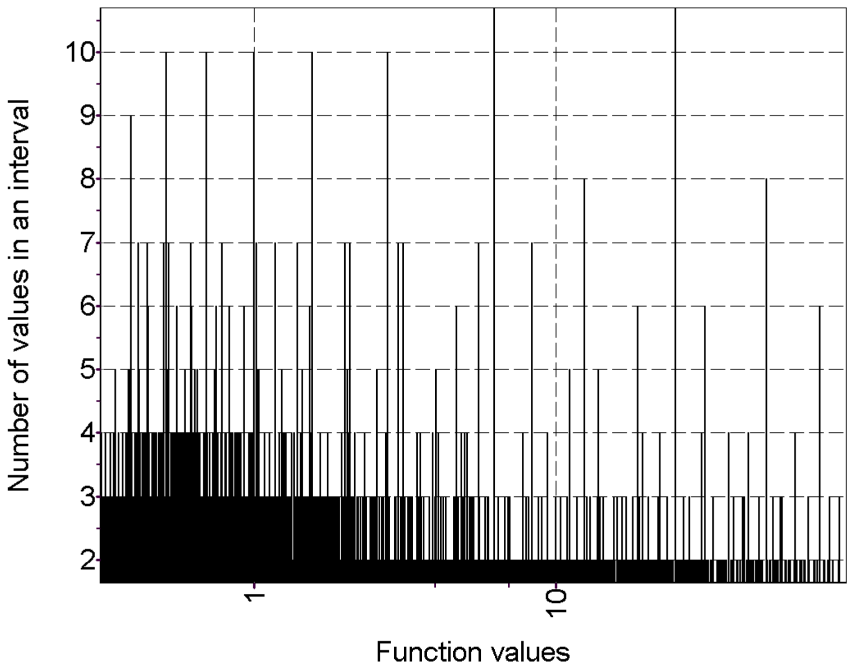

Fig. 2: Frequency distribution obtained with number of the numerical values in the scale 110,000 (of those, nonzero intervals are 48,800). $j = 0.5\ldots1.8$, $v = 0.02\ldots2$.

Fig. 2 shows an example of the frequency distribution at $j = 0.5\ldots1.8$ with a step 0.025 and at $v = 0.05...2$ with a step 0.01. Although the form of the distribution depends on the range of variation j and v, the number of intervals they are divided, split range mode (step-by-step or random), and the number of processed values, but in all cases the amplitude peaks or the frequency concentrations are revealed on graphs.

In Fig. 2 from left to right the peaks of the first order (the highest) are located at the radii (in a.u.): 0.39, 0.50 (a possible orbit), 0.70, 1.0, 1.55, 2.75, 6.2, 12.3, 18.7 (a second-order peak), 25, 31 (a second-order peak), 50, 74. Moreover, most of the values are in good agreement with the actual orbital radii of the planets. In comparison their actual values are: 0.39, 0.72, 1, 1.52, 2.5-3.0, 5.2, 9.54, 19.2, 30.6, 30-50, 38-98, including the asteroids orbit (2.5-3.0) and the tenth planet orbit (38-98).

Of course, such simple simulation can not give a complete numerical coincidence. The more important thing is a possibility for the frequency distributions to determine the most probable values of the functions describing various processes or objects; therefore, the most stable (preferred) states of these processes or objects can also be determined [1, 2].

References

1. Belyakov A.V. Is the Field of Numbers a Real Physical Field? On the Frequent Distribution and Masses of the Elementary Particles. *Progress in Physics*, 2010, v.3, 53-60.

2. Belyakov A.V. Finding the Fine Structure of the Solutions of Complicate Logical Probabilistic Problems. *Progress in Physics*, 2010, v.4, 36-39.