Probabilistic Factors as a Possible Reason of the Stability of Planetary and Electronic Orbits

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An explanation is proposed that probabilistic factors cause the existence of the stable planetary orbits and electronic ones. It is confirmed when constructing frequency distributions of relevant virials.

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

Thus, K. I. Dombrowski has revealed a possible connection of the sizes of planetary orbits to density of rational numbers on the number axis [1]. On the other hand, S. E. Shnoll has experimentally observed dependence of the fine structure of the normal distributions of various physical processes upon the algorithms that determine these processes [2]. It can be assumed that discrete nature of the normal distributions (and, apparently, any others) has a fundamental character.

An array of numbers that are the result of some computation algorithm can be analyzed by means of the frequency distribution*. As an example, one considers the distribution of 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 regarded as a 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 take arbitrary values, for example, from 1 to 100. Then the frequency distribution of the array of values of the function $(z/v)^2$ has the form shown in Fig. 1.

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

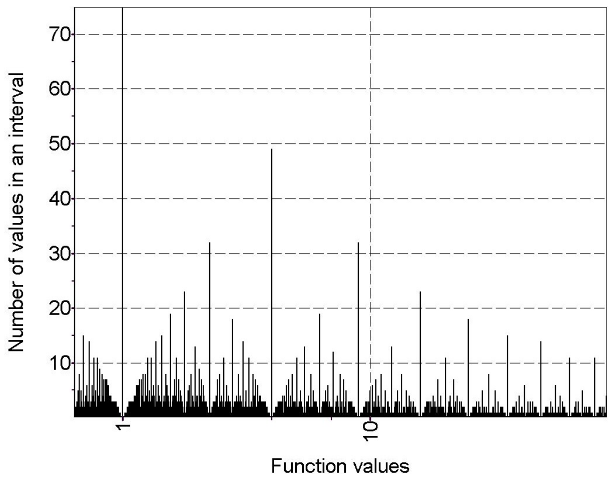

Fig. 1: Frequency distribution obtained with number of the numerical values in the scale 9,800 (of those, nonzero intervals are 3,300).

function $(z/v)^2$ along the X-axis: 1, 4, 9, 16, etc., that is, orbital radii in the Bohr's 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 other, more complicated cases.

Let one consider the distribution of the planetary orbits in the solar system. Their stability can to some extent be explained by the phenomenon of orbital resonance, but this explanation is certainly not enough. As for the well-known Titius-Bode formula, then it should not be found in any of the known 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:

$$R_0 = \frac{\gamma M}{v_0^2}\,, \tag{1}$$

where γ is the gravitational constant.

In this case it would seem the frequency distribution for the orbit positions cannot 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 has not been equivalent to a point with a mass equal to the mass of the Sun, and other disturbing factors could have been.

*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 Excel©; any other software can be applied as well.

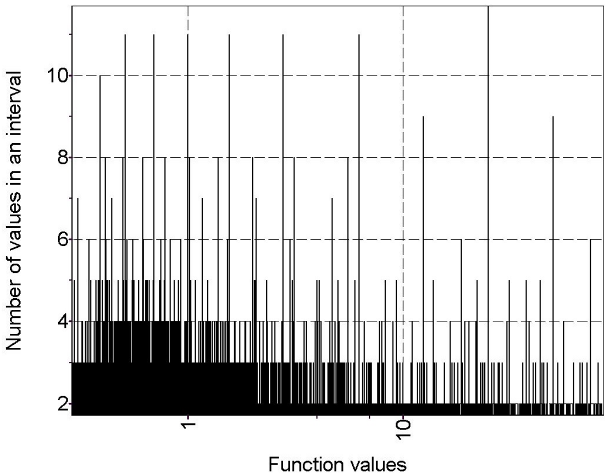

Fig. 2: Frequency distribution obtained with number of the numerical values in the scale 110,000 (of those, nonzero intervals are 48,800), $j = 0.5 \ldots 1.8$, $v = 0.02 \ldots 2$.

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

$$R = \frac{j}{v^2}\,, \tag{2}$$

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

Fig. 2 shows an example of the frequency distribution of the array of values of the function (2) at $j = 0.5 \ldots 1.8$ with a step 0.025 and at $v = 0.05 \ldots 2$ 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, and 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 [3, 4].

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References

1. Dombrowski K. I. Rational numbers distribution and resonance. *Progress in Physics*, 2005, v. 1, 65–67.
2. Shnoll S. E. Cosmic physical factors in random processes. Svenska fysikarkivet, Stockholm, 2009.
3. 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.
4. Belyakov A. V. Finding the fine structure of the solutions of complicate logical probabilistic problems. *Progress in Physics*, 2010, v. 4, 36–39.