Review
of the Thesis for the Magister's Degree in Physics

A TORSION PENDULUM INVESTIGATION OF TRANSIENT MACHIAN EFFECTS

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The study presented in this thesis rests on the assumption that the Mach principle is true. The essence of the Mach principle is that the inertial force acting on a body results from its gravitational interaction with all bodies in the Universe. In the Newtonian mechanics, an inertial force is an inherent characteristic of a body, and the mass of the body is a measure of this force. Proceeding from the assumption that the Mach principle is true, the author argues that if a body is subject alternately to acceleration and deceleration, the variations in mass are not in phase with the variations in gravitational potential, and as a result the inertial mass of the body experiences oscillations.

For a given time interval both the increase and the decrease in the mass of a body average zero, and a change in mass, in the author's opinion, cannot be measured experimentally. A jump in mass can be detected if the object is subjected to the action of some external periodic force. The subject of investigation is a capacitor connected with piezoelectric cells that move the capacitor upward and downward with a frequency twice as fast as the frequency of the electrical oscillations. In this case, the resulting force caused by a change in the inertial mass of the dielectric is non-zero. This experimental arrangement was proposed by J. F. Woodward, supervisor of studies of the candidate for a degree.

The candidate has developed a method allowing highly accurate measurements of changes in the mass of a dielectric. As to this method, it might be well to point out the following: If an appreciable change in mass does take place, it could readily be detected in the process of charging and discharging of the capacitor. This could be done owing to the comparatively low frequency (in the order of some tens of kilohertz). The piezoelectric cells only add complexity to the experiment.

A possible practical implementation of this effect may be associated with rocket engines harnessing variations in the mass of a body. The concept of such an engine is the use of many capacitors discharging one after the other, and this, naturally, should increase the jump in mass and, hence, produce a greater acceleration.

In the experiment performed by the author, with a power input in the capacitor in the order of 100 W, a change in the inertial mass of the dielectric has been fixed which then showed up in the action of a force of about 0.04 dyne, which is almost a million times lower than that which was predicted theoretically. The authors introduced a parameter $ç$, characterizing the departure of the actual experimental conditions from an idealized situation treated theoretically. Actually, most of the energy converts into the thermal energy of the lattice oscillations rather than going into the acceleration of ions. At the same time, this energy remains within the dielectric and, hence, it enters into formula (A.22) given in the thesis. For this reason, the introduction of the parameter $ç$, does not seem to be substantiated.

However, it can be stated that the main reason for this great discrepancy between theory and the experiment is concerned not with neglect of some energy losses, but with improper theoretical presumptions the most important of which is the validity of the Mach principle. Based on this principle, expression (A. 23) has been derived from which it follows that the change in mass $äm$ is proportional to the mass of the Universe. In actual reality, the change in mass is related to the input energy E as $äm= Å/ñ$ and is a negligibly small quantity.

The author's statement that under certain boundary conditions the Mach principle follows from the general relativity theory is puzzling since this principle is in conflict with the GRT postulates. According to one of these postulates, the gravitational mass of a body is equal to its inertial mass. Highly accurate measurements (V.B. Braginsky, V.I. Panov, The verification of the principle of equivalence of inertial and gravitational masses, Sov. Phys. JETP, Vol. 61, year 1971, p. 873) have shown that the relative difference

in these masses is less than 10^{-12}. This means that for a body of mass 1000 tons. the difference between its inertial and gravitational masses is less than one milligram.

According to the theory of J. F. Woodward, under certain conditions, acceleration of a body must result in its mass becoming negative. This inference is contrary to fact. The Newtonian mechanics and the general relativity theory have long been engineering disciplines. On their basis both the behavior of microscopic particles and the behavior of giant objects, such as neutron stars, can be described with a high degree of accuracy. The principles of these disciplines, when used in space navigation, allow one to locate objects at distances of 10^{13} m precise to 10^{2} cm.

Thus, there is **no** direct or indirect evidence manifesting the "transient Mach effect".

This subject has been discussed at a seminar of leading experts in gravitation and general relativity (Professor V.B. Braginsky's team) of the Moscow State University.

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