FEEDBACK IN GRAVITATIONAL PROBLEMS OF SOLAR CYCLE AND PERIHELION PRECESSION OF MERCURY

by
Jovan Djuric, retired UNM professor
Balkanska 28, 11000 Belgrade, Serbia
E-mail: oliverdj@eunet.rs

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ABSTRACT

Using the model with the two points, the center of mass and the center of self gravitation for any mass object, with the consequential intrinsic mass moment of that mass object, it is shown that the obvious feedback in the gravitational problems logically explains the solar cycle and also the precession of the perihelion of the planet Mercury.

INTRODUCTION

Feedback is a very familiar concept in engineering, particularly in electronic and control engineering. But it is interesting to note that the concept of feedback is not present at all in physics, more precisely in gravitational problems and astrophysics. Namely, it is obvious that in the case of the planetary system, the gravitational forces acting between the Sun and the planets must produce some modifications of the forms of the Sun and the planets, since those bodies are not absolutely rigid and are subject to deformations by the mutual gravitational forces. This is particularly obvious for the Sun, which as plasma must be deformed by the gravitational pulls of the planets. So, the question is raised how to take into account the rather obvious deformation of the Sun due to the planets, as well as the deformations of the planets themselves. Those deformations are referred to as the obvious feedback in the gravitational problems.

REPRESENTATIONS OF PLANETS AND SUN

The orbits (trajectories) of the planets around the Sun are calculated by approximating the planets and the Sun as the mass points. Such a model excludes any possibility to take into account any possible deformations of the planets and the Sun due to their mutual gravitational attractions.

This author found that another important point, which must exist for any mass distribution, is the center of self gravitation, i.e., the point at which the self gravitation is zero, v. [1] and [2]. That point, the center of self gravitation, is normally within the mass distributions, such as planets and stars, but it can be outside the mass distributions in some very unusual mass distributions. The center of self gravitation never coincides with the center of mass, except in the case of the absolute symmetry of the observed mass distribution, which can never occur in nature due to the presence of various external fields, particularly gravitational fields, which are present everywhere in nature.

The center of self gravitation is not defined in the physics literature so far to the best of knowledge of this author, cf. [1] and [2]. That omission, not a simple error, represents a very serious problem in physics, which excluded the proper analysis and the proper understanding of some very important and very interesting problems in physics.

Thus, any mass object regardless of its size, and including all elementary particles, must be represented by the two points, its center of mass and its center of self gravitation. Such representation of the observed mass object defines that mass object as a body of the finite dimensions, not a dimensionless mass point, which is very important in the analysis of some problems. The consequence of this representation of the mass object, i.e., mass distribution, by the two points, is that any mass object, and including any elementary particle, must possess its mass and its intrinsic mass moment, which is calculated with respect to its center of self gravitation. That intrinsic mass moment is zero only in the case of the absolute symmetry of any mass object, which never occurs in nature due to the inevitable presence of various field forces, particularly gravitational fields. The intrinsic mass moment of a mass distribution is an invariant characteristics of the observed mass object, but it changes if the mass distribution changes.

SOLAR CYCLE PROBLEM

As the first application of the inclusion of the center of self gravitation in the analysis, let us consider the solar cycle. The Sun is represented by its center of mass and its center of self gravitation for this analysis. Self can be omitted for brevity, unless it is very important to be emphasized.

The Sun attracts the planets from its center of gravitation, while the planets act upon the Sun at the center of mass of the Sun, thus stretching the Sun. Note that the law of equality of action and reaction must remain valid, but its application is not so simple when the mass objects are represented by the two points. Anyway, it is obvious that the Sun, being plasma, must be somewhat stretched or bulged towards the planets in the plane of the orbits (trajectories) of the planets, i.e., the ecliptic plane

If the origin of the heliocentric coordinate system is placed at the center of gravitation of the Sun, then its (Sun's) center of mass is defined by the vector $\vec{r}_{Scm}$, which must lie in the ecliptic plane, and whose absolute value is determined by and is proportional to the gravitational pulls of the planets, which also determine its instantaneous direction. The planet Jupiter, which is by far the largest planet in our planetary system, must obviously be the most influential planet in the determination of that vector $\vec{r}_{Scm}$, which obviously changes as the planets revolve around the Sun.

It is a fact that the problem of the calculation of the orbits (trajectories) of the planets represents a formidable problem, which can be solved only approximately. But the introduction of the obvious feedback makes this problem even very much more formidable. However, some interesting conclusions can be reached even without attempting to solve this problem in its entirety. The first obvious conclusion is that the vector $\vec{r}_{Scm}$ must revolve around the coordinate origin, which is mainly determined by the planet Jupiter with the minor influences of the other planets, i.e., approximately around 11 years as observed, since 11.86 years is the period of revolution of Jupiter around the Sun, and this explains the solar cycle, as will be shown presently.

The early gravitational experiments with the triangularly shaped gravitational needles made of wood or any non-ferromagnetic material and pivoted to rotate freely in the Earth's gravitational field and the new gravitational theory of the origin of the Earth's magnetic field by this author are presented and described in his papers [3] and [4] which are available on his Internet Site. His further gravitational experiments are described in his other papers, which are submitted for publication, but the papers [3] and [4] do contain the basic results. Those experimental results show clearly that the <u>intrinsic</u> mass moment of any mass object, i.e., mass distribution, is identified as its magnetic moment with a suitable constant of proportionality, which moment depends on the property of the material of the mass object and its form. Of course, to repeat once more, the <u>intrinsic</u> mass moment of a mass object is calculated with respect to the center of the self gravitation of that mass object, and is subject to variation if the mass distribution of the mass object varies.

INTRINSIC MASS MOMENT OF THE SUN AND SOLAR CYCLE

As mentioned, the coordinate origin of the heliocentric coordinate system is placed at the center of self gravitation of the Sun. Thus, the <u>intrinsic</u> mass moment of the Sun is by definition

$$\vec{M}_S = \int \vec{r}\,'\rho_{SV}\,dV' = M_S\vec{r}_{Scm} \qquad , \tag{1}$$

where ρ_{SV} is the volume mass density of the Sun, and M_S is its total mass. The vector $\vec{r}_{Scm}$ defines as stated earlier the center of mass of the Sun in the defined heliocentric coordinate system. The coordinates of integration are designated by primes as customary. Note that that center of mass depends only on and is caused strictly by the gravitational pulls of the planets, in whose assumed absence it must become approximately zero, since the Sun's self gravitation is spherically symmetrical and its centrifugal acceleration due to its rather irregular rotation is axially symmetrical, so its center of mass must be on its axis of rotation approximately.

The immediate consequence of the inevitable mass moment of the Sun due to the stretching or bulging of the Sun by the planets, i.e., due to the obvious feedback in that gravitational problem, is that the gravitational potential of the Sun must contain beside its monopolar term also a dipolar term, so that

$$U_S = \frac{GM_S}{|\vec{r}|} + \frac{G\vec{M}_S \cdot \vec{r}}{|\vec{r}|^3} \qquad . \tag{2}$$

The vector $\vec{r}$ defines the position of the observation point from the center of the self gravitation of the Sun. G is the gravitational constant. The gravitational field of the Sun is, of course

$$\vec{g}_S = -\nabla U_S = \frac{GM_S\vec{r}}{|\vec{r}|^3} + \frac{3G(\vec{M}_S \cdot \vec{r})\vec{r}}{|\vec{r}|^5} - \frac{G\vec{M}_S}{|\vec{r}|^3} \qquad . \tag{3}$$

The presence of the additional terms in the gravitational field of the Sun, which fall off as $|\vec{r}|^{-3}$, is very probably quite inconsequential for the distant planets, but it may be quite important for the planets close to the Sun, particularly for the closest planet Mercury and the precession of its perihelion. Note that the last term in (3) has a circular component, beside the radial component, and that circular component appears to be the main cause for the precession of the perihelion of the planet Mercury, or at least the significant additional contribution to that effect. This was impossible to take into account so far, since the center of self gravitation was not defined or used so far, and the obvious stretching or bulging of the Sun towards the planets due to the gravitational pulls of those planets remained unrecognized. The analysis of all these problems is outside of the intended scope of this paper.

In view of the numerous gravitational experiments of this author, it follows that the <u>intrinsic</u> mass moment of the Sun due to the gravitational pulls of the planets, particularly of the planet Jupiter, is the magnetic moment of the Sun, which revolving around the origin of the defined heliocentric coordinate system is the cause of the solar cycle. The magnetic moment of the Sun was observed to be in the ecliptic plane and normal to the axis of rotation of the Sun, v. [5].

The actual calculation of the <u>intrinsic</u> mass moment of the Sun due to the gravitational pulls of the planets should be the subject for another fairly large paper.

It should be mentioned at the end of this paper that the papers and literature on the subject of the so called "tides" on the Sun due to the gravitational pulls of the planets represent in the opinion of this author the violation of logic. Namely, the tides on the planet Earth represent the movement of the fluid water with respect to the firm ground of the Earth due to the gravitational pulls of the Moon mainly, and of the Sun and the other planets to a much lesser extent. But the Sun is only plasma, without any firm portions with respect to which such "tides" may be observed and measured. Consequently, the word "tides" should not be used in the case of the Sun, which obviously must be somehow stretched or bulged by the gravitational pulls of the planets, particularly Jupiter. The <u>only possible way to analyze correctly</u> the obvious stretching or bulging of the Sun towards the planets due to the gravitational pulls of those planets is to calculate the <u>intrinsic</u> mass moment of the Sun caused by the planets with the <u>obligatory</u> strictly defined center of self gravitation of the Sun as the coordinate origin as proposed in this paper, but that calculation must be the subject for another paper to repeat once more.

The so far used coordinate system in the analysis of the Sun, whose origin coincides with the center of mass of the Sun, cannot be used for the correct analysis of the stretching or bulging of the Sun, since in that coordinate system, the mass moment of the Sun <u>is zero by definition</u>. But the bulging of the Sun by the gravitational pulls of the planets is correctly represented <u>only</u> by the mass moment of the Sun, which must be zero by definition in that coordinate system. Such analysis with that coordinate origin leads inexorably to the logical impasse, even to some logical absurdities. It is certainly physically and logically absurd to insist that the bulges of the Sun due to the gravitational pulls of the planets must occur on the <u>both</u> sides of the Sun, as such analysis does require in order to retain zero for the Sun's mass moment, which is a must for such analysis in that coordinate system!!??

It is to this logical impasse that the omission of the definition of the center of self gravitation with the improper choice of the coordinate origin of the coordinate system has brought physics theory till today, and it will remain absurdly there until the center of self gravitation is defined and used as the coordinate origin of the coordinate system as proposed in this paper. Some physical and logical absurdities in the theory of the elementary particles also occurred due to the omission of the proper definition of the center of self gravitation as shown by this author in his other papers. The proper choice of the coordinate origin of the coordinate system of observation and/or analysis is of the paramount importance. Remember the huge problem of the geocentric system versus the heliocentric system. It is only the problem of the proper choice of the coordinate system and its coordinate origin.

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APPENDIX

PROBLEM OF PHYSICS

by
Jovan Djuric, retired UNM professor
Balkanska 28, 11000 Belgrade, Serbia
E-mail: oliverdj@eunet.rs

PACS: 01.50.Zv

ABSTRACT

The center of mass and the center of gravitation of a mass distribution are defined. It is pointed out that, apparently, the center of gravitation has not been defined or used in the published physics literature so far.

The center of mass is defined in all physics textbooks as the point with respect to which the mass moment of the observed mass distribution is zero. On the other hand, the center of gravity is defined in some textbooks, but not mentioned at all in many other textbooks. The center of gravity in the textbooks where it is mentioned and defined is shown to be in fact the center of weight and identical to the center of mass of the observed mass distribution in the uniform external gravitational field. As such, the center of gravity is totally unnecessary and should not be even mentioned at all. It is obvious that *gravity* in the expression *center of gravity* in the textbooks where it is mentioned means nothing else but *weight*, i.e., identically as in the expression *specific gravity.*

However, the language is a living tool, and it changes in time. The word *gravity* has assumed for quite some time also the meaning of the gravitation or the gravitational field as evident, for example, from the name of a scientific journal CLASSICAL AND QUANTUM GRAVITY, where GRAVITY obviously does not refer to WEGHT but certainly to GRAVITATIONAL FIELD. The expressions – words *gravity, gravitation* and *gravitational field* are fully interchangeable according to any college edition of the Webster dictionary, including also the American Heritage Dictionary, electronic version. Thus, the expression *center of gravity* may be misleading in some situations. So the textbooks, which omit altogether that expression *center of gravity*, are certainly justified.

Hence, the expression *center of gravity* may be sometimes interpreted erroneously as the center of the gravitational field, or simply, the center of gravitation. However, it is interesting to note that the center of gravitation is not mentioned or defined or used in the published physics literature so far to the best of knowledge of this author. Consequently, the question is raised what is the meaning of the expression the center of gravitation and how that term should be defined?! The only logical definition is that the center of gravitation (or self gravitation for emphasis) is the point at which the gravitation, i.e., the gravitational field of the observed mass distribution is zero.

It is easily concluded from those definitions that the center of mass and the center of self gravitation are the two distinctly different points which coincide only in the case of the absolute symmetry of the observed mass distribution. Those two points are the characteristic invariants of the observed mass distribution, which obviously vary if the observed mass distribution changes.

As an illustrative example, consider the simplest mass distribution consisting of the two point masses m_1 and m_2 at a distance d from each other. Let d_{cm} designate the distance of the center of mass measured from the mass point m_1 along the line connecting these two point masses, then $m_1 d_{cm} = m_2 (d - d_{cm})$, which yields $d_{cm} = dm_2 / (m_1 + m_2)$. On the other hand, let d_{cg} designate the distance of the center of gravitation measured from the same point mass m_1 along the line connecting these two point masses, then applying the Newton’s law of gravity we write $Gm_1 / d_{cg}{}^2 = Gm_2 / (d - d_{cg})^2$, which yields the expression $d_{cg} = d\sqrt{m_1} / (\sqrt{m_1} + \sqrt{m_2})$. G is, of course, the universal gravitational constant. For $m_1 > m_2$, it is easily proved that $d_{cg} > d_{cm}$. It is obvious from the obtained expressions that these two centers coincide, if and only if those two point masses become equal, in which case that simplest mass distribution becomes symmetrical evidently.

It must be mentioned that the calculation of the center of gravitation is not a simple task. In the general case when the mass distribution is defined by the volume mass density ρ_m , the center of gravitation $\vec{r}_{cg}$ is the solution of the integral equation

$$\vec{g}(\vec{r}_{cg}) = G\int \frac{(\vec{r}_{cg} - \vec{r}\,')\rho_m dV'}{\left|\vec{r}_{cg} - \vec{r}\,'\right|^3} = 0 \qquad , \qquad (1)$$

where the notation is customary. It is evident from this equation that the problem of calculating the center of gravitation of a general mass distribution is far from simple, while the calculation of the center of mass is relatively a simple task of the integrations. That may be the explanation of the fact that the center of gravitation was never defined or used so far in the published physics literature to the best of knowledge of this author, to repeat once more. Of course, the center of mass $\vec{r}_{cm}$ is in the general case defined by

$$\int (\vec{r}\,' - \vec{r}_{cm})\rho_m dV' = 0 \qquad \text{i.e.} \qquad \vec{r}_{cm} = \left(\int \rho_m dV'\right)^{-1} \cdot \int \vec{r}\,'\rho_m dV' \qquad . \qquad (2)$$

This obvious deficiency in the physics textbooks - literature should be eliminated.