CENTRAL FORCE

(According to "*Hypothesis on* MATTER")

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Abstract: Currently, a central force – an apparent effort between two free bodies along the line joining them – is estimated in relativistic frames of references. Estimation of magnitude and direction of central force on planetary bodies/central body in a planetary system assumes that the centre of planetary system is static in space. While considering a satellite's orbit, centre of corresponding planet is assumed static in space. Although such calculations help to determine relative positions of the bodies, it obscures causes of many other important phenomena related to planetary motion. Determining magnitude and direction of central force with respect to an absolute reference can give us logical explanations to many puzzling phenomena on planetary motions/systems.

Keywords: Central force, planetary motion, planetary orbits, planetary spin, Hypothesis on MATTER.

Introduction:

"Hypothesis on MATTER" describes an alternative concept. In it: Whole matter in the universe is in the form of quanta of matter. Matter content of a body and the energy about it are distinctly separate. Matter content is the total sum of three-dimensional matter in a body. Energy is the stress developed due to 'distortions' in the natural arrangements of basic matter particles in and about a body. Matter content and energy content of a body cause and support each other for their existence and stability. They are not convertible into each other. Entire space is filled with '2D energy fields', two-dimensional latticework formations by basic one-dimensional quanta of matter. 2D energy fields, in various directions and planes, passing through a point, co-exist. Although, 2D energy fields are made of (apparently) rigid quanta of matter, it has all properties of an ideal fluid. Parts of 2D energy fields, within a macro-body's spatial dimensions, contain sufficient distortions to sustain integrity and stability of a macro body in its current state. This part of 2D energy fields is the body's 'matter field'. Distortions in a matter field are the 'work-done', existing about the body and it determines the state of (motion of) the macro body. 'Force' is the rate of work being stored about a macro body with respect to rate of the body's displacement in space. Hence 'effort' is more appropriate name of the entity, which performs the work. Action of an effort is simple structural reshaping of a matter field and the resulting motion of 3D matter particles present in the region.

State of (motion of) a macro body depends on the work (energy stored) about its matter field rather than on the effort applied on it. All apparent interactions between matter bodies take place through the medium of 2D energy fields – the all encompassing universal medium. This avoids assumption of mysterious 'actions at a distance' through empty space. There are no 'pull forces' or 'rigid bodies' in this concept. All efforts, currently classified into various types of natural forces, are different manifestations of 'only one type of effort (force)' and it is of 'push nature'. Work is transmitted only in straight lines and separately in each spatial plane. Efforts in different planes do not form a resultant. Efforts in the same plane in different directions interfere to reduce or increase each other's efficiency to produce the body's motion. Independent displacements of a body, produced by external efforts in different directions or in different planes may be regarded, together, to be resultant motion of the body in 3D space system. In this article, present conventions of 'pull forces' and their resultants are used for clarity. A free body is that macro body, which is free from all interferences other than the efforts/actions considered. Although a force can exist only when there is an acceleration/deceleration of related matter body, in this article, the term 'force' is often used in its conventional sense to represent an effort.

Tendency of a 2D energy field to attain serenity does not allow static distortions in it. Transfer of distortions in the matter field of a macro body carries the associated 3D matter particles and thus produces macro body's motion. This inertial action, about a macro body, maintains macro body's state (of motion). A change in the inertial actions about a macro body produces its acceleration. If certain work is invested into or removed from a body, the body will attain a stable state only after inertial delay, during which the work within the body stabilizes. This is true even after the action of effort is terminated. Matter is inert; it has no ability to move or act on its own. Associated matter field-distortions of matter (bodies) produce all apparent actions, presently assigned to the matter (bodies).

Presence of 3D matter particles in a 2D energy field breaks its continuity. Discontinuity causes imbalance in the 2D energy field. Pressures applied by the 2D energy field-latticework from the sides, in an attempt to restore continuity, compress a 3D matter particle. [Basic 3D matter particles are of uniform radial size and they constitute all other superior matter bodies]. If the extents of 2D energy field on opposite sides of a matter particle are unequal, the matter particle experiences a resultant effort, which tends to move the matter particle towards the side of lower effort (pressure or force). Extent of 2D energy fields between two 3D matter particles is always less than the extent of 2D energy fields on their outer sides. As a result, matter particles are pushed towards each other. Motions of constituent particles of a macro body move the whole body. This action gives rise to the apparent gravitational attraction between macro bodies. Apparent gravitational attraction between two bodies is, relatively, a minor by-product of gravitational actions. It takes place between (spinning-disc shaped) basic 3D matter particles of both the macro bodies, which are in the same plane at any given instant. Apparent gravitational attraction, at any instant, is produced between extremely small numbers of constituent basic 3D matter particles in two macro bodies. An average apparent attraction is derived from sporadic actions between various 3D matter particles, which happen to be in the same plane at any instant. Contrary to present belief, gravitational action is enormously stronger compared to other manifestations of efforts (forces).

In Newtonian mechanics, centre of solar system is usually assumed as absolutely steady in space. This point is used as a reference for all motions in planetary system. Accordingly, we have circular/elliptical orbital paths for the planets. These apparent orbital paths justify our observations. However, since the sun is a moving body, this view cannot provide real parameters of planetary motions, except their relative positions. Shape of real orbital path of a planet in space is wavy about the mean path of the sun, alternately moving to front and rear of the sun. All conclusions expressed in this article are taken from the "*Hypothesis on* MATTER" [1]. For details, kindly refer to the same.

Gravitational attraction on a body, moving parallel to the surface of a very large body:

According to the concept, 'Hypothesis on MATTER', all efforts are applied in straight lines. Hence, gravitational attraction between two bodies in each common plane/direction is distinct and separate. There is no resultant gravitational action on the body. Gravitational efforts in each spatial plane, enclosing parts of both bodies, act separately in the same plane. Inertial actions in all separate common spatial planes, together, contribute to total or resultant inertial action on participating macro bodies.

Let us consider gravitational attraction between a small spherical body, moving parallel to the surface of a very large body in a straight line and the very large body. A small part of the surface of a very large spherical body can be considered as a plane or small part of a line parallel to this surface may be considered as a straight line. We shall assume the very large body has a straight line perimeter of infinite length and the small spherical body is moving parallel to the surface at constant relative speed ‘v’ units per second with respect to a point on the surface of the very large body on a line passing through its center and perpendicular to the direction of motion of the small body.

In the figure 1, curved line SS is the surface of a very large spherical (free) body. Gray circle B is a small spherical (free) body, moving along the straight line X_1X_2. Circles in dotted lines, A and C shows two instantaneous positions of small spherical body B, before reaching line YY and after leaving lineYY, respectively. Centre line YY is perpendicular to straight line path of the small body, X_1X_2 and passes through the centre of the very large body. Assuming the gravitational attraction between these bodies act along the line joining their centres or parallel to this line, it can be considered as ‘central force’ between the bodies.

Let us consider gravitational attraction between these two bodies, strictly in the direction of line YY or directions parallel to line YY. That is; magnitude of gravitational attraction between both bodies, in the plane containing line YY and perpendicular to line X_1X_2. Concurrently, gravitational attractions between these bodies in many other parallel planes are also active. However, they cause no inertial action in the direction of YY, but each action causes inertial action in its own direction. It is the gravitational attraction between these bodies in the common plane containing line YY and perpendicular to X_1X_2, which produce their inertial action in the direction along YY. We shall concentrate only on gravitational attraction in this direction.

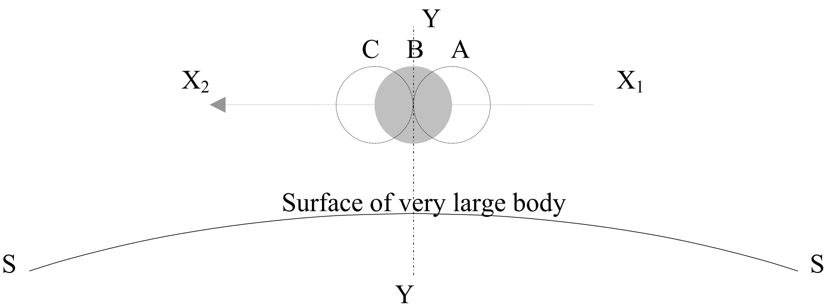

Figure 1

As the small body approaches the line YY, there are no common planes in it, parallel to line YY and perpendicular to line X_1X_2. Hence, there is no gravitational attraction between the bodies in the direction of line YY. As the forward edge of small body comes in line with line YY, both bodies start to have common planes of existence, which are parallel to line YY and perpendicular to line X_1X_2. Gravitational attraction between the bodies commences to do work in the common planes of the bodies.

As the small body moves forward, the plane, where work was being introduced, moves out of the plane of line YY and it does not have gravitational attraction in this direction any more. Since the plane of the body moved away from the plane of additional work, inertial action on this plane will cease. However, the work introduced in the plane of the small body will remain within the body and inertial action will be transferred to the next plane of the small body to the rear, which has in the mean time moved forward to occupy the plane.

As the small body moves further forward, another of its planes comes in line with the line YY. Gravitational attraction between the bodies now introduces additional work in this plane. This plane has already inherited additional work introduced into its predecessor plane (which has moved forward, away from the plane of line YY. Thus, this plane will have more additional work in it, compared to its predecessor-plane. This process will continue and each of the planes of the small body will receive additional work, which will cause the small body’s inertial motion in the direction of line YY. Magnitude of additional work, received in the planes of the small body, has a gradient increasing towards the rear of the body. Small body’s inertial motion at corresponding acceleration will continue, until additional work, introduced by gravitational attraction in the direction of YY, is lost from the body. This can happen either due to action of an external effort in opposite direction or due to displacement of the whole body away from plane containing line YY and perpendicular to X_1X_2. Since the small body is under linear motion at constant speed along line X_1X_2, it moves out of the plane containing line YY and lose all additional work in the direction of line YY, introduced into its matter field by gravitational attraction between the bodies.

At any instant, a plane at the forward end of the small body has lesser additional work and hence it will have lesser inertial action compared to a plane at the body's rear end. This amounts to an effective shift in the 'centre of gravity' of the small body to the rear of its 'centre of mass'. Uneven action of external effort about the small free body's centre of mass simultaneously produce linear as well as spin motions of the small body.

Long before gravitational attraction along line YY has ceased, similar action would have commenced along the adjacent diameter of the large body. In a certain balanced condition, direction of path of smaller body is continuously modified so that the small body moves in curved path, parallel to the surface of the larger (static) body. Thus, gravitational effects on the small body (in perpendicular direction to its line of motion) have a continuous action towards the larger body. Since gravitational attraction between the bodies is simultaneously effective on both the bodies, similar actions will take place on the very large body also.

If the large body has a flat surface, direction of line YY, at any relative position of the bodies will always remain perpendicular to the direction of linear motion of the small body. Although there will be differences in the magnitudes of additional work introduced into different planes in the matter field of the small body, action of the central force will continue in the same direction. As the magnitude of radial work, in the small body's matter field increases, small body will continuously accelerate to increase its velocity at a constant rate towards the large body, until its matter field is saturated for additional work. Limit of saturation corresponds to absolute linear speed of the small body. When in saturated state, magnitudes of additional work introduced into small body's matter field and the additional work lost from its matter field, due to forward displacement of the body, will balance each other. Changes in the magnitude of additional work due reduction in the distance between the bodies is ignored. Difference in the magnitudes of radial work in the forward and rearward part of the small body will cause a shift in body's centre of gravity. Shift of centre of gravity from centre of mass of the free body causes part of central force to act as a torque and spin the small body in the plane of its linear motion.

Efforts on a planetary body:

In this article, all actions of a planetary body due to its inherent inertial motion are credited to linear motion / work (attained by the planetary body before it entered into its stable orbital path) and all actions due to the central force are credited to radial motion / work in it, towards the central body. A body is defined by the measurements of space, occupied by its matter content and by its mass, representing the quantity of its matter content. A free body tends to move in a straight-line due to associated inertia. Apparent gravitational attraction between two macro bodies is the result of apparent gravitational attraction between their 3D matter particles. Inertia (of a body) does not apply any effort on the body. While inertia maintains a moving planetary body in its straight-line motion, it is the apparent gravitational attraction between the planetary and its central body (by its action on each of the bodies, separately) that changes the direction of planet's motion and produce its spin motion. This effort, apparently between two free macro bodies, moving about each other, along the line joining them, is the 'central force'. Actions on each body are between it and the surrounding 2D energy fields. Concurrent actions on two bodies, considered together, may be interpreted as an apparent action between them. Although gravitational action on each body is separate, such actions on the central and planetary bodies, when considered together, provide a central force (apparent attraction) between them. A planetary body is apparently attracted towards the central body and vice versa. (Apparent) gravitational actions between two bodies take place only in common planes occupied by them. Actions, similar to the orbital motion of a planetary body analysed here, takes place on central body also.

Efforts in different planes do not interfere. They act on 3D matter particles independently. 3D matter particles are moved by each of the efforts in its own direction/plane, to produce resultant direction of a combined-body's motion. Matter field of a moving macro body contains additional work required for its original linear and spin motions. Work is stored in its matter field in the form of matter field-distortions. In this article, we shall neglect all work, stored in a macro body's matter field, for sustenance of its stability and integrity. A free body, which is associated with such work, will continue its linear motion in a straight line at constant linear speed and maintain its spin motion at constant angular speed. Original work, associated with a planetary body was invested into its matter field by external efforts (forces), including apparent gravitational attraction towards the central body, before its entry into orbital path. Another external effort is required to change the state of constant motions of the orbiting body. We shall deal with only those additional distortions (work), introduced into body's matter field, by external efforts to change the state of body's motion, after it has entered its stable orbital path, in order to transform its linear motion into motion along curved paths as required for orbital motion.

Magnitude of matter field-distortions (work) about a macro body, moving in circular path, does not change. However, to keep changing the direction of motion at a constant rate, distortions in its matter field are modified continuously by a 'centripetal force'. Changes in the magnitude of additional work (matter field-distortions) produce a body's accelerating stages. In the case of motion in a circular path, irrespective of changes in the matter field-distortions, magnitude of total matter field-distortions in the matter field of the macro body is kept constant. Instantaneous velocity of the macro body depends on the magnitude of distortions in its matter field. Acceleration of the macro body depends on the variation in the magnitude of additional work (magnitude or direction of additional distortions in the matter field) associated with it. A planetary body (moving in circular apparent orbit), simultaneously, maintains a constant acceleration towards the central body, maintains linear motion at constant velocity along the orbital path, maintains linear motion at constant velocity towards the central body and maintains (almost) constant acceleration of its spin motion.

In the following paragraphs, displacement of a planetary body along its orbital path is called planetary body's linear motion and planetary body's displacement towards the central body (by the central force) is called radial motion. Disregarding its spin motion, a planetary body has two simultaneous (linear) motions, a linear motion nearly tangential to its orbital path and a radial motion towards the central body. Linear motion of the planetary body is deflected, outward from orbital path (away from the median path) [4]. Angle between the direction of linear motion and the tangent at the location of the planetary body on its orbital path (the 'drifting rate') produces a perpendicular component of the linear motion. This, a real motion of the planetary body (away from the centre of curvature of its path), replaces the assumed motion produced by an 'imaginary centrifugal force' on it. Major part of (linear) work within a planetary body's matter field carries it along the orbital path. Unlike motion in a circular path, relative direction of radial motion to the tangents varies at different points on the real orbital path [4]. Most of the matter field-distortions, producing linear motion and radial motion of the body, are in different planes. Hence, they do not produce resultant motions. However, simultaneous and independent displacements of the planetary body, produced by the matter field-distortions in different planes, may be understood together as its resultant motion.

In the following analysis, planetary orbit about a central body (moving in a much larger circular path) is considered. Real orbital path of a planetary body about its central body is of wavy-shape about the mean path of the central body. The planetary body alternately moves to the front and to the rear of the central body. As a planetary body moves in its real orbital path, its relative direction to central body changes through half a circle, alternately in either direction. This is in contrast with present assumption of a planet moving around the central body in full circles/ellipses (an assumption created by using relativistic reference frame with centre of solar system as a static point). Changes in relative directions between the bodies cause variations in efforts and their actions. Explanations given below are for relative position of the central and planetary bodies, when the tangents to their paths are parallel and the bodies are moving in the same direction, the planetary body being on the outer side of central body's path. At all other relative positions between the bodies, magnitudes and directions of central force and its components differ from those calculated below. There are points on the orbital path, where the central force acts in the same direction or in opposite direction to direction of planetary body's linear motion. For details on the behaviour of planetary bodies, please refer article 'Planetary Orbits' [4].

Action of a central force:

Central force, between a planetary body and its central body, is provided by apparent gravitational attraction between them. [Real gravitational actions, by the 2D energy fields, pushing these bodies towards each other is considered as apparent attraction between them]. Direction of this apparent attraction, at 'datum points' in the orbit (points on the orbital path where the planetary body is displaced by π/2 radians from central body's median path), is perpendicular to the direction of planetary body's linear motion. Action of the central force depends on the magnitude of additional (radial) distortions; it is able to invest into the planetary body's matter field. Magnitude of additional (radial) matter field-distortions, a body is able to store is governed by its absolute linear speed (with respect to the space - 2D energy fields). Action of apparent gravitational attraction is instantaneous and continuous. As long as the participating bodies occupy common planes, apparent gravitational attraction between them, continues to invest additional distortions in their matter fields to produce inertial actions.

Figure 2 shows a spherical (homogeneous) planetary body of radius 'r' and mass 'm' with its centre at O_2 and moving to the left (in relation to the central body, the planetary body is overtaking the central body in its linear displacement). Point C is the foremost point on the planetary body. The central body, not shown in the figure, is assumed as situated towards the bottom of the planetary body, in the figure. The central body is also moving in the same linear direction as the planetary body. When the planetary body is on the outer side of central body's path, its linear speed is higher and when it is on the inner side of central body's path, its linear speed is lower than central body's absolute linear speed.

We shall consider the left half of the spherical planetary body. Magnitude of matter field-density (density of additional distortions introduced into the matter field of a body) depends on the duration of action of an effort (force). Density of (radial) matter field distortions increases from C to O_2. Planetary body moves in the direction from O_2 to C. Absolute linear speed of the body being V m/sec, whole body takes 2r/V seconds to pass a point in space. Due to difference in sizes of central and planetary bodies, it takes more than an instant for the planetary body to move across the central body, in any tangential direction. Apparent gravitational attraction (central force) on the planetary body is in radial direction, parallel to AB, for whole of this time. Additional (radial) work introduced by the central force in a cross section of the planetary body depends on the time, during which it is under the influence of apparent gravitational attraction in that particular direction. Density of additional (radial) matter field distortions increases in planes from C to O_2.

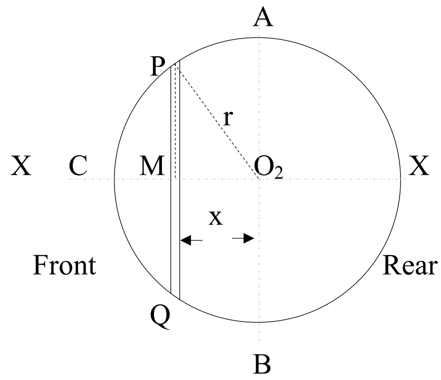

Figure 2

Take an elementary circular section PQ (cut by planes parallel to AB and parallel to XX, at distances x and x+dx from AB) of thickness dx, perpendicular to the axis XX. Magnitude of matter field-distortions in any part of the body is proportional to its volume.

$$PM^2 = O_2P^2 - O_2M^2 = r^2 - x^2, \qquad CM = r - x$$

$$\text{Volume of } PQ = \pi \times PM^2 \times dx = \pi(r^2 - x^2)dx$$

$$\text{Matter density of } PQ = m \div \frac{4\pi \times r^3}{3} = \frac{3m}{4\pi \times r^3} \qquad (1)$$

$$\text{Matter content of section } PQ = \frac{3m}{4\pi \times r^3} \times \pi(r^2 - x^2)dx = \frac{3m(r^2 - x^2)dx}{4r^3}$$

Using inverse square law for apparent attraction due to gravitation;

$$\text{Central force on section } PQ = \frac{3m(r^2 - x^2)dx}{4r^3} \times \frac{MG}{D^2} = \frac{3MGm(r^2 - x^2)dx}{4r^3D^2}$$

Where, M is the mass of the central body, G is the gravitational constant in 3D space system and D is the distance between the centres of section PQ and the central body. Force of central force is the rate of investment of (radial) matter field-distortions into section PQ of the planetary body with respect to the distance moved, towards the central body.

Central force acts on section PQ for the time, during which it exists under the effort. Since, we are considering the motion of the planetary body across its orbital path; we are interested only in those common planes, which are perpendicular to planetary body's orbital path and containing both the central and planetary bodies. [At other points (other than datum points) on the orbital path, the common planes are not perpendicular to orbital path]. As soon as the front edge of the planetary body reaches the perpendicular line passing through the rear edge of the central body, both bodies start to have common planes. Number of common planes increases as the planetary body moves forward to overtake the central body. [On the inner datum point it is the central body, which overtakes the planetary body. In relativistic reference frame, this appears as the planetary body has reversed its direction of motion and it is moving in opposite direction]. Duration of action of the central force on the planetary body, in perpendicular direction to orbital path, is from the instant the planetary body's forward edge enters the common plane with the central body to the instant the planetary body's rear edge leaves the common plane with the central body. Duration of action of the central force on the planetary body, in perpendicular direction to orbital path before the section PQ comes in the common plane with the central body, is from the time planetary body's forward edge enters the common plane with the central body to the time, when the section PQ enter the common plane.

Distance between the front edge of the planetary body and section, PQ = (r – x).

Time duration = displacement / speed = (r – x) / V

The planetary body takes this much time to overtake the central body in tangential direction to central body's surface.

Let the constancy of proportion between an external effort and magnitude of distortions introduced by it is equal to 'k'. This constant of proportion for different bodies is different. It depends on the size of the body in the direction of effort, consistency and distribution of the body's matter content and the body's matter density.

Magnitude of (radial) matter field-distortions invested in section PQ $= \frac{3MGm\left(r^2 - x^2\right)dx}{4r^3D^2} \times \frac{(r-x)}{V} \times k$

$$= \frac{3MGmk}{4r^3D^2V}\left(r^2 - x^2\right)(r-x)dx$$

Magnitude of total (radial) matter field distortions in the hemisphere $ACBO_2A$ of the dynamic planetary body, when the whole of planetary body has common planes with the central body,

$$W_1 = \sum_{x=0}^{x=r} \frac{3MGmk}{4r^3D^2V}\left(r^2 - x^2\right)(r-x)dx = \frac{3MGmk}{4r^3D^2V}\int_{x=0}^{x=r}\left(r^2 - x^2\right)(r-x)dx$$

$$= \frac{3MGmk}{4r^3D^2V}\int_{x=0}^{x=r}\left(r^3 - r^2x - rx^2 + x^3\right)dx = \frac{3MGmk}{4r^3D^2V}\left| r^3x - \frac{r^2x^2}{2} - \frac{rx^3}{3} + \frac{x^4}{4}\right|_0^r$$

$$= \frac{3MGmk}{4r^3D^2V}\left(r^4 - \frac{r^4}{2} - \frac{r^4}{3} + \frac{r^4}{4}\right) = \frac{3MGmk}{4r^3D^2V} \times \frac{5r^4}{12} = \frac{5MGmkr}{16D^2V}$$

Since the value of gravitational constant G, in 3D space system, is determined experimentally, we can take that the operation by the constant of proportion, k, is also automatically accounted for in the value of G. Hence, we may neglect the factor k in the above equation.

Thus, $$W_1 = \frac{5MGmr}{16D^2V} \qquad (2)$$

This is the highest magnitude of total (radial) work – additional matter field-distortions – invested in the forward half-part of planetary body's matter field, at the point considered on the real orbital path. As long as the planetary body maintains its absolute linear speed and other parameters, total magnitude of (radial) work cannot exceed this value, irrespective of the duration of central force's action. In other words, action of central force on the planetary body has a saturation limit. Acceleration of a body takes place only during changes in the magnitude of additional work in its matter field. Since, in this case, there will be no change in the magnitude of (radial) work in planetary body's matter field, it cannot accelerate but can only move at a constant linear speed as provided by the existing (radial) work, towards the central body.

Accelerating / decelerating stages of the planetary body are very short and takes place during initial and final stages of central force's action.

Similarly, taking other (rear) hemisphere AO_2BEA, of the planetary body, as shown in figure 3, we may determine the (radial) work invested in it by the central force as follows;

Take an elementary circular section PQ (cut by planes parallel to AB at distances x and x+dx from AB) of thickness dx, perpendicular to the axis XX. Magnitude of matter field distortions in any part of the body is proportional to its volume and its distance from C.

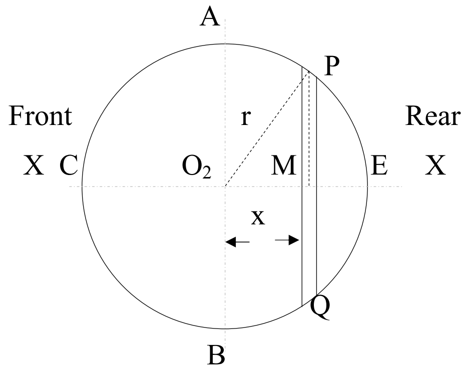

Figure 3

$$(PM)^2 = (O_2P)^2 - (O_2M)^2 = r^2 - x^2, \qquad CM = r + x,$$

$$\text{Volume of section PQ } = \pi\left(r^2 - x^2\right)dx$$

$$\text{Matter density of section PQ } = m \div \frac{4\pi \times r^3}{3} = \frac{3m}{4\pi \times r^3} \text{ kg/m}^3$$

Matter content of section PQ =

$$\frac{3m}{4\pi \times r^3} \times \pi\left(r^2 - x^2\right)dx = \frac{3m\left(r^2 - x^2\right)dx}{4r^3}$$

$$\text{Central force on section PQ } = \frac{3m\left(r^2 - x^2\right)dx}{4r^3} \times \frac{MG}{D^2} = \frac{3MGm\left(r^2 - x^2\right)dx}{4r^3D^2}$$

Central force is the rate of investment of matter field distortions in the section PQ, in the direction of central body.

$$\text{Time duration in which PQ is under central force } = \left(r + x\right) \div V$$

(Taking the constant of proportion equal to k), Magnitude of (radial) matter field distortions invested in PQ

$$= \frac{3MGmk\left(r^2 - x^2\right)dx}{4r^3D^2} \times \frac{(r + x)}{V}$$

$$= \frac{3MGmk}{4r^3D^2V}\left(r^2 - x^2\right)\left(r + x\right)dx$$

Total magnitude of (radial) matter field distortions in the hemisphere AO2BEA of the dynamic planetary body,

$$W_2 = \sum_{x=0}^{x=r} \frac{3MGmk}{4r^3D^2V}\left(r^2 - x^2\right)\left(r + x\right)dx = \int_{x=0}^{x=r} \frac{3MGmk}{4r^3D^2V}\left(r^2 - x^2\right)\left(r + x\right)dx$$

$$= \frac{3MGmk}{4r^3D^2V}\int_{x=0}^{x=r}\left(r^3 + r^2x - rx^2 - x^3\right)dx = \frac{3MGmk}{4r^3D^2V}\left| r^3x + \frac{r^2x^2}{2} - \frac{rx^3}{3} - \frac{x^4}{4}\right|_0^r$$

$$= \frac{3MGmk}{4r^3D^2V}\left(r^4 + \frac{r^4}{2} - \frac{r^4}{3} - \frac{r^4}{4}\right) = \frac{3MGmk}{4r^3D^2V} \times \frac{11r^4}{12} = \frac{11MGmrk}{16D^2V}$$

Since the value of the gravitational constant G, in 3D space system, is determined experimentally, we can take that the operation by the constant of proportion, k, is also automatically accounted for in the value of G. Hence, we may neglect the factor k in the above equation.

$$\text{Thus,} \qquad W_2 = \frac{11MGmr}{16D^2V} \tag{3}$$

Sum total (radial) work held in the body's matter field; from equations (2) and (3),

$$W = W_1 + W_2 = \frac{5MGmr}{16D^2V} + \frac{11MGmr}{16D^2V} = \frac{MGmr}{D^2V} \tag{4}$$

Difference in the magnitudes of work invested by the apparent gravitational attraction at different parts of the planetary body effectively shifts its centre of gravity. As the gradient of work-density is increasing towards the rear of the planetary body, it appears as if the rearward parts of the planetary body have greater gravitational attraction in comparison to forward parts of the body. Quantum of center of gravity's shift, from the centre of mass, varies as the planetary body moves in its real orbital path. It will be highest at the outer datum point on the real orbital path. There will not be any shift of centre of gravity, from the centre of mass at points on the real orbital path, where central force acts along the direction of linear motion of the planetary body (this happens at two points on the inner side of central body's path).

Unequal momenta of efforts about the centre of mass, of a free planetary body, cause its simultaneous radial and spin motions. Equal momenta on either side of centre of mass, together, cause the radial motion of the planetary body towards the central body. They act as single set of work (force) through the centre of mass of the planetary body. Remaining one-sided momentum produces a couple about centre of mass and causes planetary body's spin motion. Work, in the front hemisphere and equal part of work in the rear hemisphere, together, produce planetary body's radial motion towards the central body. Direction of radial motion, at the datum points, is perpendicular to the orbital path. This has effectively shifted centre of gravity of the body to its rear.

Total (radial) work acting through the centre of gravity,

$$W_g = \frac{5MGmr}{16D^2V} \times 2 = \frac{5MGmr}{8D^2V} \tag{5}$$

This work, of magnitude $5MGmr \div 8D^2V$, acts to produce planetary body's (radial) motion towards the central body. No body can stay motionless in space. Hence, the factor V is always of positive value. In the above case, the planetary body is considered at the outer datum point in the real orbital path. Hence, its absolute linear speed, V, is the same at which the planetary body moves across the central body in tangential direction to its surface. However, at other points on the real orbital path, the linear speed at which the planetary body moves across the central body are different and depends on their relative positions. At two points on the real orbital path on the inner side of central body's path, for an instant each, the planetary body's linear motion and the direction of central force coincide. At these points, magnitudes of V are zero. This means that as long as the planetary body is at these points, it cannot reach a steady constant radial velocity and it will continue to accelerate as per physical laws.

Remaining (radial) work, acting about the centre of mass of the body and producing spin motion of the planetary body,

$$W_s = \frac{MGmr}{D^2V} - \frac{5MGmr}{8D^2V} = \frac{3MGmr}{8D^2V} \tag{6}$$

{See the article "Planetary Spin"}

Magnitudes of the central force and its components, W_g and W_s, also depend on the position of the planetary body on the real orbital path in relation to the central body. In the relative positions, considered above, direction of central force is perpendicular to planetary body's real orbital path. There are points on the real orbital path at which the planetary body experiences the central force in the same or in opposite direction to the direction of its linear motion along the real orbital path. At these points, magnitudes of central force and radial velocity will be much higher and the magnitude of its spin component will be much smaller or zero. At all other points in the real orbital path, magnitudes of central force and its components will vary, cyclically, as the planetary body moves along its real orbital path.

The name 'central force' is a misnomer. In normal case, it means an effort on a planetary body towards the center of its elliptical/circular apparent orbital path. In a circular orbital path, direction of central force is always perpendicular to the direction of planet's linear motion. Circular/elliptical orbital paths are apparent geometrical structures created by relativistic considerations in mechanics. In real orbital path, central force is not directed to any central point; it is directed towards the central body. Perpendicular direction of central force to planetary body's linear motion is satisfied only at datum points. At all other points in the real orbital path direction of central force vary through a full circle during every two subsequent segments of real orbital path. Although, the central force is directed towards the central body, its direction is very rarely perpendicular to planetary body's linear motion. Mathematical descriptions in this section allude to actions at datum points.

Magnitude of radial velocity:

Central body of a planetary system is very large, compared to a planetary body. Therefore, it takes some time for the planetary body to move across the central body, in any tangential direction. During this time, they maintain common planes, parallel to the radial direction. As long as the common planes are present, planetary and central bodies are under apparent gravitational attraction in that radial direction. Apparent gravitational attraction, in any radial direction, begins as soon as the forward part of planetary body comes in line with the central body and continues to be present as the planetary body advances in its real orbital path, moving across the central body. Central force in a radial direction ceases when the planetary body has fully crossed the central body in that tangential direction. At the end of this time, all the work invested into the planetary body's matter field, for the production of its radial velocity in this direction, has been utilized (to change the direction of linear motion and to spin the planetary body) and the planetary body will end its radial motion in this direction. Actions of the central force on the planetary body overlaps for near-by points on the real orbital path. Radial displacement of the planetary body towards the central body, at every consecutive instant, is along different directions and it (in any radial direction) stops as soon as work introduced into the body's matter field for motion in that particular direction is lost from the body's matter field. Consequently, despite continuous displacement towards the central body, a planetary body never reaches any nearer to the central body (disregarding variations required for eccentricity of the orbital path).

Equation (5) gives total (radial) matter field-distortions (or work), held in a planetary body's matter field and producing its constant radial motion, u, towards the central body. Unlike in the normal cases, where an external effort introduces matter field distortions in a body during its action, the case of planetary system is different. This is because of the constant change in the direction of motion of the planetary body. In any radial direction, magnitude of matter field-distortion remains constant. That is, there is no natural accelerating stage for the planetary body. It moves at a constant radial velocity along any radius in consideration (this consideration lasts only for an instant). Accelerating stage, to develop this constant velocity, took place before the body came in the line of direction considered. Kinetic energy of a body, moving at constant speed, 'u' is equal to '$mu^2 / 2$'. Mass of the planetary body 'm' is constant and its kinetic energy depends on its velocity.

Comparing these two, kinetic energy due to radial motion; $\frac{mu^2}{2} = \frac{5MGmr}{8D^2V}$

Radial velocity of the planetary body towards the central body at datum point, $u = \sqrt{\frac{5MGr}{4D^2V}}$ m/sec (7)

Equation (7) is valid only under condition that 'V' has a positive value. When the direction of central force and the direction of planetary body's linear motion coincide, for an instant, the planetary body has no motion across central body. Directions of both its (linear and radial) motions are along the same line and magnitude of 'V' becomes zero. At this point, the planetary body is under acceleration/deceleration and value of 'u' does not reach a steady value.

Although (radial) velocity, as given by equation (7), appears to be of constant magnitude (disregarding changes in D and V), work causing that velocity is being renewed at every instant. Work is used up and new work of equal magnitude is invested throughout the planetary body's matter field. Continuous loss of work from the matter field keeps the velocity of the body constant despite continuous investment of work into the matter field. Investment of work into the matter field produces a body's acceleration. Yet, in this case, final velocity is constant irrespective of body's acceleration. This is because of the limitation on body's (matter field's) ability to store more work (in radial direction) than a constant maximum magnitude, due to planetary body's linear motion. Planetary body starts to accelerate at a rate 'a' in its planes towards the central body, when it starts to cross a common plane with the central body. Acceleration in this direction ceases when the whole body has crossed the common planes with the central body in that radial direction. Thereafter it is unable to store more work of this nature. Long before this time, similar actions would have started in nearby planes also.

Constancy of radial velocity is mentioned only to emphasis that continuous action of central force in any particular direction does not change planetary body's radial velocity in that direction, unless directions of central force (or its component) coincide with the direction of body's linear motion. Component of central force, which coincides with the direction of linear motion, produces acceleration/deceleration of the planetary body like any other external effort. Depending on the present position of the planetary body in its real orbital path, radial velocity of the planetary body varies continuously and cyclically.

At outer datum points in real orbital path, due to highest (absolute) linear speed parallel to central body's surface (situation used for above calculations), magnitude of radial work received by the planetary body is the least. Three-eighth part of this work is used to spin the planetary body (as shown in the above calculations). As the planetary body moves along its real orbital path, approaching median path, time duration for the planetary body to overtake the central body in the tangential direction increases. This increases magnitude of radial work invested in planetary body's matter field. Longer duration of acceleration/deceleration increases/reduces radial velocity steadily. However, angular difference of shift in the centre of gravity of the planetary body decreases to reduce its torque-component on the planetary body. For some time, after the planetary body has crossed the median path to inner side of central body's path, its direction of linear motion is in opposition to the direction of central force. During this time, magnitude of radial motion will be highest and deceleration of planetary body will be continuous. For some time, before the planetary body is about to cross the median path to outer side of central body's path, its direction of linear motion is in the same direction as that of central force. During this time, magnitude of radial motion will be highest and acceleration of planetary body will be continuous. At both these points, centre of mass and the centre of gravity of the planetary body lie on the line of action of central force, no torque is available on the planetary body.

Conclusion:

Actions of central force on planetary bodies are never steady or constant as suggested by (Newtonian) relativistic considerations, which profess circular/elliptical planetary orbits. Apparent circular / elliptical orbits may be used to determine relative positions of moving bodies. For all other phenomena, real motions of the bodies of a planetary system, as they are related to an absolute reference frame, give logical results. By accepting the concept explained above, to determine magnitude and direction of central force in relation to wave-shaped real planetary orbital path (with respect to a point in the universal medium, outside the planetary system), many phenomena (like: planetary spin, common spin-plane of all bodies in a planetary system, tides, deflection of tide from local meridian, apparent lengthening of terrestrial days, higher equatorial spin speed of certain planets, etc.) can be logically explained.

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