

PLANETARY ORBITS

According to 'MATTER (Re-examined)'

Nainan K. Varghese, matterdoc@gmail.com

<https://www.matterdoc.in/>

Abstract: It is an established fact that the Sun is a moving macrobody in space. By simple mechanics, it is physically impossible for a free planetary body to orbit *around* a moving central body in any type of geometrically closed path. Both a circle and an ellipse are closed geometrical figures. Hence, elliptical planetary orbital paths (closed geometrical figures) around the Sun are false or apparent. A planetary body moves in the same direction as its central body. It is only when we imagine reversing the direction of a planetary body's motion on one side of the central body's path that we can get a geometrically closed figure for the planet's apparent orbital path. Use of a reference frame, related to a static central body, causes planetary orbital paths to appear as closed geometrical figures around central body. Because the central body is moving, this does not reflect physical reality. Although they help to explain apparent phenomena, all properties attributed to elliptical/circular planetary orbital paths are unreal. Real physical actions are restricted to real entities, and they have to be understood with an absolute reference. Since the elliptical shape of a planetary orbit is imaginary, it has limitations in explaining real actions in nature. The mechanism of orbit formation and limitations of orbiting macrobodies, described in this article, are based on radically different dynamics from an alternative concept presented in the book 'MATTER (Re-examined)'.

Keywords: Planetary orbits, apparent orbit, real orbit.

Apparent orbital path:

Real orbital paths of all macrobodies in a galaxy are around the galactic centre. It is very large and contains many points of similar appearance in relation to the central body of the respective planetary system. Hence, it is convenient for us to use a much smaller structure, the 'apparent orbit', with unique reference points on it for all practical purposes. Apparent orbit is a small part of the real orbital path, between two identical appearances of the central body, looking from a planetary body (e.g., one solar year). It is an imaginary concept, where the shape of the path, the speed of the planetary body and the directions of motions are manipulated to suit observations. As such, it has no logical mechanical basis. It depicts the appearance of a system, where it is assumed that the central body, by some imaginary mechanism (change of reference frame), is held stationary at the centre of apparent orbit, and the planetary body moves at a (constant) linear speed by an equally imaginary mechanism.

The only cause of action, within a planetary system, is the 'central force', due to gravitational attraction, which accelerates a planetary body towards the centre of apparent orbit – the central body. Parameters of this action are mathematically manipulated to produce the required orbital motion around the central body that matches observations. [In the case of Earth, they are also used to establish proofs of validity for the "Laws of motion" and "Laws of universal gravitation"]. While doing this, the greater motions of the planetary body before it became a planet, and the motion or path of the central body are ignored. Apparent orbit is convenient for predicting the cyclic features that take place annually. However, taking an apparent orbit as the real orbit of a planetary body is highly illogical and incorrect.

Mathematical treatments of apparent planetary orbits around a central macrobody assume the direction of the 'central force' on the planetary body is always (almost) perpendicular to the direction of its linear motion. This is an essential requirement for all laws derived from apparent orbits. In real orbital motion, it is not so. Radial motion of a planetary body is perpendicular to the orbital path only at the 'datum points', situated farthest and nearest to the galactic centre. At all other points on the orbital path, the angle between radial motion and orbital

path varies as the sine of the relative angular position of the planetary body with respect to the central body and the median path. In circular (elliptical with no eccentricity) orbits, the 'central force' does not affect a planetary body's linear motion at all. It can produce only centripetal acceleration and displacement towards the central body. Centrifugal displacement by an imaginary 'centrifugal force' is essential to nullify the centripetal displacement of the planet towards the central body.

Unlike in apparent orbit, in the case of real (wavy) orbital motion, the direction of action of the 'central force' on the planetary body changes through a full circle during its passage through two subsequent segments of (one wave of) the orbital path. This behaviour will not sustain mathematical proofs derived from calculations, using parameters of apparent orbit. 'Central force' not only produces centripetal acceleration of a planetary body towards the central body but also affects its linear speed. The magnitudes of these effects depend on the relative positions of the planetary body and the central body. Since the direction of centripetal acceleration changes through full circles, depending on the relative positions of macro bodies, it has components assisting or opposing the planetary body's linear motion.

A non-circular apparent orbit has two reference points on it, the periapse and the apoapse. They are situated diametrically opposite on an apparent orbit. Apoapse is the point on the apparent orbital path where a planetary body is considered slowest and farthest from the central body, and periapse is the point on the apparent orbital path where a planetary body is considered fastest and nearest to the central body. In real orbital motion of a planetary body, periapse is a point on its path where it is nearest to the central macrobody, but it need not be fastest at this point. And the apoapse is a point on its path where it is farthest from the central body, but it need not be slowest at this point. In the case of Earth, these points are called perihelion and aphelion, respectively.

Although perihelion(s) are points on the orbital path at which the planetary and central bodies approach nearest, the highest linear speed of the planetary body occurs at points on the orbital path farthest from the galactic centre. Similarly, although aphelion(s) are points on the orbital path at which the distance between the planetary and central bodies is farthest, the lowest linear speed of the planetary body occurs at points on the orbital path, nearest to the galactic centre. While considering apparent planetary orbits (around a static central body), the linear speed of the planetary body is reduced to a small fraction of its real speed in space (equal to its linear speed relative to the central body), with a corresponding reduction in the planet's kinetic energy. Action, by the associated kinetic energy on a planet, is likely to appear in a miniature form.

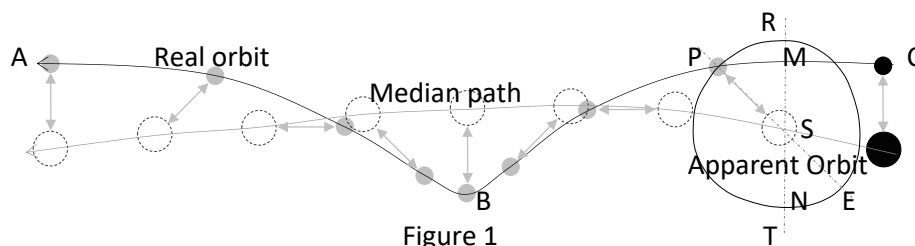


Figure 1 compares the real path of an orbiting macrobody and its apparent orbit for a duration of one apparent orbital period. The grey central line shows the central body's path. A black, wavy line is the path of a planetary body. The larger black circle shows the central body, and circles in dotted lines show its future positions. A small black circle shows the orbiting macrobody, and grey circles show its future positions. Double-headed arrows show the directions of the 'central force' between the macrobodies at various positions as they move along their paths.

The apparent orbit of a planetary body, when it is at position P with the central body at S, is shown by the oval in Figure 1. As a planetary body moves, its apparent orbit moves along with the central body. The planet's perihelion is at P, and its aphelion is at E. In real motion, the highest and lowest linear speeds of the orbiting macrobody occur when it is at 90° away from the path of the central body, at M and position B (represented by N on apparent orbit), respectively. All parameters of apparent orbit and orbital motion are related to perihelion and aphelion. From its position at C until B, the orbiting macrobody is in front of the central body, and hence it is retarded in its linear motion. From B to A, the orbiting macrobody is behind the central body, and hence it is accelerated in its linear motion. Line RST is a radial line connecting the central body to the centre of its curved path

$$\tan W = \frac{u \sin [\theta + (-\alpha)]}{V + u \cos [\theta + (-\alpha)]} = \frac{u \sin (\theta - \alpha)}{V + u \cos (\theta - \alpha)} \quad (3)$$

W is the rate of inward angular deflection between directions of present velocity, V, and resultant velocity, VR. It is 'deflection rate'. Rate of outward angular deflection, α , between the direction of present motion, V, and the tangent at P is the 'drifting rate' of the planetary body, away from the tangent to the orbital path. In order to make orbital path curve towards median path of planetary (and central) body, resultant of inward deflection rate, W, and outward drifting rate, α , should be in the same direction as that of radial motion of planetary body, u, with respect to tangent XX at P. [As shown in figure 2, magnitude of W should be more than magnitude of α]. Vertical component (to tangent XX) of present speed V is a real motion, substituting for the effect of (presently) imaginary 'centrifugal force'. This real motion produces a drifting rate, α .

Circular orbit:

A circular orbit is a possible path traced only around a central body with no translational motion. The centers of stable galaxies are the only points (entities in the universe) without translational motion. In all other cases, a circular orbit is an apparent orbit related to a central body that is assumed to be static. For motion in a circular path, the instantaneous resultant linear speed, VR, should be equal to the present instantaneous linear speed, V. Both linear speeds are with respect to an absolute reference. That is, at any instant, the resultant linear speed of a planetary body in its curved path is equal to its present linear speed. In a circular orbit, the deflection rate, W, is constant. A planetary body has no angular acceleration in its orbital path. It maintains a constant distance from the central body. Hence, the drifting rate remains constant and equal to $-\alpha$ all around the orbital path. If the value of negative (clockwise) drifting rate, $-\alpha$, can be maintained constant at half the value of positive (anti-clockwise) deflection rate, W, by external means or by natural process, the direction of resultant linear motion of the planetary body along its curved path will deflect at a constant rate. The magnitude of the resultant linear speed of a planetary body remains constant, equal to its present (instantaneous) linear speed.

In figure 3; arrow PA represents present (absolute linear) speed, V, of a planetary body P. Direction of its present linear motion is deflected from tangent XX to planetary body's curved path at P by an angle, $-\alpha$. Arrow PB represents planetary body's radial motion, u, perpendicular to tangent XX to its curved path at P. Instantaneous resultant speed of planetary body, VR, is represented by arrow PP1. Its direction is deflected from present linear speed, V, by an angle $+W$.

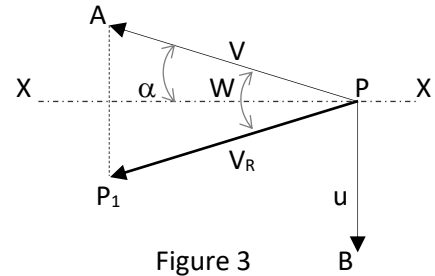


Figure 3

$$AP_1 = PB = u. \quad \angle APB = \frac{\pi}{2} + (-\alpha),$$

For circular path, $V = V_R$; Substituting V for V_R in equation (2); $V^2 = V^2 + u^2 + 2Vu \sin \alpha$

$$u = -2V \sin \alpha \quad (4)$$

$$\sin \alpha = -\frac{u}{2V}$$

$$-\alpha = \sin^{-1} \frac{u}{2V} \text{ radian} \quad (5)$$

When orbital path is circular, 'central force' acts in perpendicular direction to tangent at any point on it.

$$\text{Hence, } \angle \theta = \frac{\pi}{2},$$

Substituting value of 'u' from equation (4) in equation (3),

$$\tan W = \frac{(-2V \sin \alpha) \sin \left(\frac{\pi}{2} - \alpha \right)}{V + (-2V \sin \alpha) \cos \left(\frac{\pi}{2} - \alpha \right)} = -\frac{2V \sin \alpha \sin \left(\frac{\pi}{2} - \alpha \right)}{V - 2V \sin \alpha \cos \left(\frac{\pi}{2} - \alpha \right)} = -\frac{2 \sin \alpha \cos \alpha}{1 - 2 \sin \alpha (\sin \alpha)}$$

$$\begin{aligned}
&= -\frac{\sin 2\alpha}{1-2\sin^2\alpha} = -\frac{\sin 2\alpha}{\cos^2\alpha + \sin^2\alpha - 2\sin^2\alpha} = -\frac{\sin 2\alpha}{\cos^2\alpha - \sin^2\alpha} \\
&= -\frac{\sin 2\alpha}{\cos 2\alpha} = -\tan 2\alpha, \quad \therefore W = -2\alpha
\end{aligned}$$

For circular orbit, where deflection rate W is positive, drifting rate α is in negative direction, with magnitude $\alpha = W \div 2$

$$\text{Substituting from equation (5), } W = -2\alpha = 2\sin^{-1} \frac{u}{2V} \quad (6)$$

$$\frac{W}{2} = \sin^{-1} \frac{u}{2V}, \quad \sin \frac{W}{2} = \frac{u}{2V} \quad (7)$$

For a circular orbit, where direction of W is positive: Drifting rate, $\alpha = W \div 2$ in negative direction. (8)

This is the condition required for a circular orbital path of a planetary body *around* a static central body or circular parts of other orbital paths at points on their orbital path, where they exhibit properties of circular orbit. Resultant linear speed of a planetary body, along a curved path, remains a constant, whose magnitude is equal to its present (instantaneous) linear speed. The angular speed of a planetary body about the centre of a circular path (deflection rate) is equal to twice its drifting rate (in the opposite angular direction), and its magnitude is constant.

The direction of linear motion of a planetary body that desires to enter a circular orbital path has to be outward from the tangent at the point of entry. Drifting rate of a planetary body at the point of initial entry on the datum orbit (clockwise from tangent at P, as shown in Figure 3), required to achieve a circular orbital path (in this case), is precisely equal to half of the deflection rate produced by the 'central force' at the present distance between the centre of the orbital path and the point of entry. Hence, a planetary body is required to approach the entry point P from within the datum orbit. These conditions can be fulfilled only in cases where an orbital path is formed around a static central body.

All natural planetary bodies are much smaller than their central bodies, and they approach their orbital paths from outside the datum orbits. A planet in real orbital motion traces segments of curved paths on either side of its median path (which is also the median path of the central body). A circular orbital path requires semi-circular paths on either side of the median path. Due to the constantly changing relative direction of the 'central force', it is also impossible to maintain a constant angular speed by a planetary body about a moving central body. Consequently, natural planetary bodies cannot have circular orbital paths. However, certain points on their orbital path may exhibit properties of a circular orbital path.

Exceptions to the above are probable cases of static binary systems at the centers of stable galaxies or other planetary systems formed by the explosion of a static parent macrobody, also at the center of a stable galaxy, where planetary bodies are thrown away from a static central body to enter their orbital paths from within. Since no macrobody, except stable galaxies, can remain in space without translational motion, this is only a theoretical consideration.

A circular orbit is a critical condition. Parameters of a planetary body (maintained in circular orbit by external means, in addition to 'central force') are very precise. Once in orbit, its drifting rate can be easily changed by external factors. Changes in 3D matter-contents of planetary and central bodies or their linear speeds due to external influences are bound to affect the stability of a circular orbit due to changes in the drifting rate. A collision with debris in space or even uneven distribution of 3D matter-contents of planetary bodies can influence the state of a circular orbit. It should also be noted that no macro bodies smaller than a stable galaxy can remain static in space.

To form a circular apparent orbit, parameters of an orbiting planetary body should apparently satisfy equation (6); $W = 2\sin^{-1}(u \div 2V)$, at every point on its orbital path. All factors in the equation should remain constant. This is achieved by ignoring the state of motion of the central body and the original state of motion of the planetary body. The apparent circular orbit of a planet is its smallest apparent orbit. It is the datum orbit of a

planetary body for the present parameters of the central and planetary bodies. This equation is also applicable to (apparently) circular parts of non-circular orbits.

Elliptical Orbit:

Like a circular orbit, an elliptical orbit around a static central body is also an apparent orbit. Variations in the parameters of an orbiting planetary body change its datum orbit. Consequently, even if a planetary body were in an apparent circular orbit, its datum orbit changes with the variation of any parameter. Such changes or differences in the magnitude of the drifting rate change the shape of its orbital path. Non-circular apparent orbits are based on the datum orbits of planetary bodies. A deformed datum orbit becomes a non-circular apparent orbit. Deformation of the datum orbit is with respect to two points (midpoints) on diametrically opposite sides. Either the forward or rearward part of the non-circular apparent orbit is placed within, and the other part is placed outside the datum orbit, as shown in Figure 4.

Figure 4 shows two possible representative deformations of the datum orbit into elliptical apparent orbits. The circle in a dashed line shows the planetary body's datum orbit around a static central body. Oval shapes in red and green show elliptical apparent orbits of a planetary body around a static central body, formed corresponding to its parameters during entry into the orbital path. Since a planet apparently moves in a non-circular path, the tangent to a point on the apparent orbital path is not perpendicular to its instantaneous radius, along which the 'central force' is acting. But, there are two points that lie on an apparent orbital path, at which conditions required for circular apparent orbits are satisfied. At these points, the direction of radial motion (action of 'central force') is perpendicular to the tangents to the apparent orbital path, and variation in length of its radius reverses direction.

If the radius of apparent orbit was increasing before the planet reaches the point, it will gradually decrease after crossing this point, till planetary body reaches a similar point on the diametrically opposite side of the apparent orbit. At this point, the direction of change in distance between central and planetary bodies reverses, and the radius of apparent orbit gradually increases till the planetary body reaches the original point on the apparent orbit. Periodic changes in the length of the radius of apparent orbit, about a mean value, sustain a planetary body in its non-circular stable apparent orbital path. Points, where reversals of changes in radius of apparent orbit occur, are periapse (perihelion) and apoapse (aphelion) at which the planetary body is nearest or farthest from the central body. Other reference points on the real orbital path are the outer datum point and inner datum point, where planetary bodies attain their highest and lowest linear speeds.

In the case of real orbital motion, the planetary orbital path is not around a central body but oscillates about a common median path shared by the central and planetary bodies. The angular speed of a planetary body does not correspond to motion in a circular or elliptical path. Deflection rate of orbital path from median path is limited, alternating on both sides; whereas, total deflection of 2π radians in the same direction is required for every apparent orbit.

Planetary body accelerates up to the outer datum point, where it moves to the front of the central body, or it decelerates up to the inner datum point, where it moves behind the central body. The highest and lowest linear speeds of a planetary body occur at datum points. Datum points need not coincide with either the perihelion or aphelion of the apparent orbit, assumed above. Datum points of the orbital path are situated on radial lines of galactic radius (a line perpendicular to the median path of central and planetary bodies), passing through the centers of both central and planetary bodies.

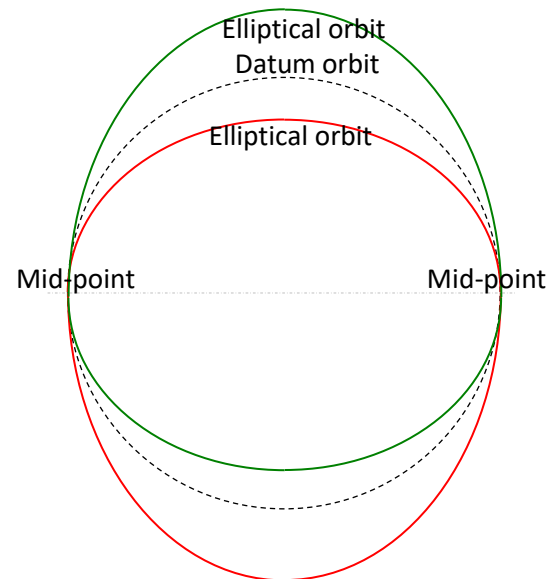


Figure 4

Periapse and apoapse indicate points on the orbital path of a planetary body, which are nearest and farthest from the central body. They have no other relations to the motions of an orbiting planetary body. Periapse and apoapse may be displaced along the orbital path without affecting other parameters (except for planetary spin speed) of orbital motion. But points at which a planetary body's linear acceleration and linear deceleration change are fixed in space with respect to the median path of the central body and depend on the relative position of the planetary body.

Figure 5 shows a planetary body P at the periapse of the apparent orbital path. Arrow PA represents the present instantaneous linear speed, V , of the planetary body. Arrow PB represents its radial speed, u . Arrow PP_1 represents its resultant (future) instantaneous linear speed, V_R . Outward drifting rate is equal to $-\alpha$. W is the inward deflection rate of resultant motion. Changes due to angular acceleration and deceleration add to drifting and deflection rates. The motion of a planetary body at perihelion of its non-circular apparent orbit exhibits properties of motion in a circular apparent orbit. Angle between PB and tangent XX at periapse is 90° .

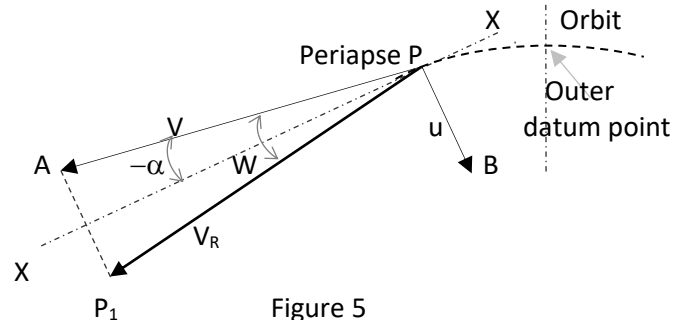


Figure 5

Figure 6 shows a planetary body P at apoapse of apparent orbital path. Arrow PA represents the present instantaneous linear speed, V , of the planetary body. Arrow PB represents its radial speed, u . Arrow PP_1 represents its resultant (future) instantaneous linear speed, V_R . Outward drifting rate is equal to $-\alpha$. W is the inward deflection rate of resultant motion. Changes due to angular acceleration and deceleration add to drifting and deflection rates. The motion of a planetary body at aphelion of its non-circular apparent orbit exhibits properties of motion in a circular apparent orbit. Angle between PB and tangent XX at apoapse is 90° . Conditions for circular orbital paths exist at aphelion and perihelion.

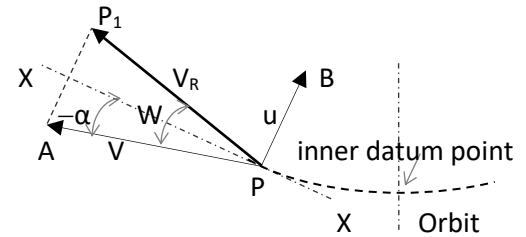


Figure 6

Angle between tangent to orbital path and 'central force' = $\theta = \pi/2$

Putting $\tan W = \frac{\sin W}{\cos W}$ and $\theta = \pi/2$ in equation (3)

$$\frac{\sin W}{\cos W} = \frac{u \sin(\frac{\pi}{2} - \alpha)}{V + u \cos(\frac{\pi}{2} - \alpha)} = \frac{u \cos \alpha}{V + u \sin \alpha} \quad (9)$$

During circular orbital conditions, drifting rate ($-\alpha$) is equal to half of deflection rate W .

Putting drifting rate, $-\alpha = W/2$ in equation (9);

$$\frac{\sin W}{\cos W} = \frac{u \cos(-\frac{W}{2})}{V + u \sin(-\frac{W}{2})} = \frac{u \cos \frac{W}{2}}{V - u \sin \frac{W}{2}}, \quad V \sin W - u \sin W \sin \frac{W}{2} - u \cos W \cos \frac{W}{2} = 0$$

$$V \sin W - u (\cos W \cos \frac{W}{2} + \sin W \sin \frac{W}{2}) = 0, \quad V \sin W - u \cos(W - \frac{W}{2}) = 0$$

$$V \sin(2 \frac{W}{2}) - u \cos(\frac{W}{2}) = 0, \quad V \times 2 \sin(\frac{W}{2}) \cos(\frac{W}{2}) - u \cos(\frac{W}{2}) = 0$$

$$2V \sin \frac{W}{2} \cos \frac{W}{2} - u \cos \frac{W}{2} = 0, \quad 2V \sin \frac{W}{2} - u = 0,$$

$$\sin \frac{W}{2} = u \div 2V \quad (10)$$

$$W = 2 \sin^{-1} \frac{u}{2V} \quad (11)$$

Equation (10) is the same as equation (7) for a circular apparent orbit. Therefore, a non-circular apparent orbital path has two points on it, where it behaves like a circular path. Since the curvature of the orbital path varies continuously, the behavior of a non-circular apparent orbit as a circular apparent orbit, which lasts only for an instant. As soon as the point of periapse or point of apoapse is passed, the planetary body will pursue its non-circular apparent orbital path.

Drifting rate at periapse, α_{peri} , is half of the deflection rate, W_{peri} , and at apoapse, drifting rate, α_{aphe} , is half of the deflection rate, W_{aphe} , in magnitudes. As shown in Figures 5 and 6, directions of drifting rates, with respect to radial motion, are always the same. Included angles between u and the direction of approach of the planetary body are of the same sense. In a non-circular orbit, equation (11) gives the deflection rate. Equation (7) for a circular apparent orbit is applicable to a non-circular apparent orbit at its periapse and apoapse, where circular apparent orbital conditions exist.

Deflection rates, W , for periapse and for apoapse are in opposite directions. If a planetary body entered its datum orbital path from within (with a negative drifting rate), it would move towards its apoapse, where conditions of circular apparent orbit take place. Similar conditions (required for circular apparent orbit) should also repeat at a point 180° away from periapse / apoapse, as the case may be. A stable apparent orbit can be formed only if these conditions are met. At periapse, the direction of change in the distance between central and planetary bodies reverses. A planetary body moves towards apoapse, where the condition for a circular apparent orbit is fulfilled once again.

At mid-points between periapse and apoapse, inward deflection rate, W , becomes equal to outward drifting rate, $-\alpha$. The resultant angular speed of the planetary body becomes zero. For an instant, the planetary body moves in a straight line. The direction of linear motion of the planetary body is tangential to the apparent orbital path at these points, but the directions of radial motion, u , are not perpendicular to tangents at those points. Therefore, conditions for circular apparent orbit are not fulfilled at mid-points in non-circular apparent orbits. Tangents at mid-points are not parallel to the major axis of a non-circular apparent orbit.

In a theoretical elliptical path, tangents at the ends of its minor axis are parallel to the major axis. In cases explained above, they are not so. Hence, the apparent orbital path of a planet is oval (with its narrower end towards apoapse) in shape rather than elliptical. However, due to the very small eccentricity of apparent orbits, which we come across in nature, they are usually considered elliptical or circular. Present laws on planetary motion are formed for elliptical apparent orbits.

In a real orbital path, points at which the orbital path of a planetary body crosses the median path of the central body may be considered as mid-points. After the midpoint in the real orbital path, between periapse and apoapse, the angular difference between radial and linear motions of the planetary body diminishes. When a planetary body has moved from the midpoint by an angular displacement equal to the deflection of periapse or apoapse from datum points, the linear and radial motions of the planetary body become co-linear. At this point, deflection rates, W , of a planetary body due to the 'central force' become zero. However, the planetary body continues to move in its curved orbital path under the influence of the drifting rate, $-\alpha$, which continues to decrease in magnitude.

Once this point on the real orbital path is passed, the direction of the angular difference between linear and radial motions of the planetary body reverses. Deflection rate, W , and drifting rate, α , are in the same direction for a short while until the drifting rate, α , changes its sense. Planetary body angularly accelerates till it reaches another point, where conditions for circular orbital motion are fulfilled, where deflection rate, W , and drifting rate, α , are in opposite directions, and the magnitude of W is twice that of α . This point is apoapse of real orbital path. Thereafter, similar processes continue to sustain the stable orbital motion of a planetary body in its real orbit about its central body.

$$\text{Resultant orbital angular speed at perihelion} = W_{\text{peri}} - \alpha_{\text{peri}} = \omega_{\text{peri}}$$

$$\text{Resultant orbital angular speed at mid-point} = W_{\text{mid}} - \alpha_{\text{mid}} = 0$$

$$\text{Resultant orbital angular speed at aphelion} = W_{\text{aphe}} - \alpha_{\text{aphe}} = \omega_{\text{aphe}}$$

Time to move from periapse to apoapse = $T \div 2$. Where, T is orbital time period.

Resultant orbital angular speed of a planetary body, in its real orbital path, decreases from ω_{peri} at periapse to zero at mid-point, increases in the opposite direction from zero at mid-point to ω_{aphe} at apoapse, decreases from ω_{aphe} at apoapse to zero at mid-point, and increases in the opposite direction from zero at mid-point to ω_{peri} at periapse. The total angular deflection of a planetary body during every cycle of real orbital motion is zero. [Total angular deflection of a planetary body during every cycle of apparent orbital motion is a full circle – 2π radians]. Therefore, the real orbital path of a planetary body is wavy about the median path of the central body.

The location of ‘periapse’ or ‘apoapse’ of the real orbital path depends on the location of the point of entry of the planetary body on the datum orbit and the drifting rate at the time of entry. For an appropriate drifting rate, the point of entry can be at periapse or apoapse of the orbital path. The locations of periapse and apoapse can shift later due to external influences, whereas the locations of datum points remain at their relative positions with respect to the central body.

Limits of angular speeds at the point of entry:

The real orbit of a planetary body is a path in space whose attributes are related to the parameters of the central and planetary bodies. It is improbable for planetary bodies to originate in their orbital paths. They have to come to their orbital paths from space, away from orbital paths. For a smooth transition from the planetary body’s motion outside the orbital path into motion in an orbital path, all parameters of the central and planetary bodies at the time and at the point of entry should be the same, as if the planetary body were moving in a stable orbital path at that point.

Every potential planetary body has a datum orbit about its central body. Parameters of the datum orbit depend on the 3D matter-contents of the central and planetary bodies, the present linear speeds of the centre and planetary bodies, and the relative direction of approach of the planetary body. A planetary body has to approach the datum orbit in a near-tangential direction, rather than on a collision course towards the central body. If a planetary body’s parameters do not suit an appropriate datum orbit, it will be unable to move in a stable orbit about the central body.

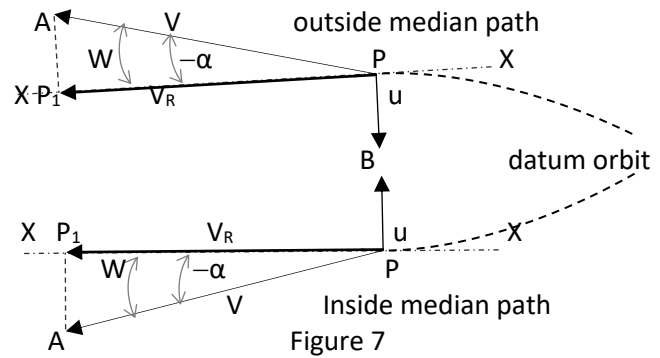
‘Central force’ on a planetary body (towards the central body) is active even when it is very far from its future orbital path. Hence, parameters of a planetary body’s motion are modified continuously, even before it enters an orbital path about the central body. A planetary body enters its orbital path in a near-tangential direction, subject to the following limits. Macro bodies, approaching the point of entry into their datum orbits (outside certain limits of angular speeds with respect to the central body), are unable to form stable planetary bodies.

To approach a moving central body, a potential planetary body from the rear has to move at a greater linear speed in a direction almost parallel to the direction of the central body’s motion. The magnitude of the (outward) drifting rate of a planetary body depends on the angle of approach and the linear speed of the planetary body. The magnitude of the (inward) deflection rate depends on the magnitude of the ‘central force’. As the magnitude of the drifting rate, α , increases to a limit in the negative (outward) direction, the deflection rate, W , becomes insufficient to overcome the drifting rate, and the direction of the macrobody’s resultant motion, V_R , becomes parallel to (or deflected outward from) the tangent to the datum orbit at the point of entry. Macrobody will fly away in a tangential direction to (or away from) the datum orbit. Such a macrobody is unable to form a stable orbital path about the central body.

Figure 7 shows the angular speeds of the planetary body at the points of entry near the outer datum point and inner datum points on the datum orbit. The upper figure shows a planetary body entering the datum orbit outside the median path, and the lower figure shows a planetary body entering the datum orbit inside the median path. Curved dashed lines represent parts of the datum orbit. P is the point of entry. PA is the present instantaneous linear speed, V , and PP_1 is the future instantaneous linear speed of the planetary body, V_R . $PB = u = AP_1$ is motion due to ‘central force’. $PB = AP_1$, in the figure. Future instantaneous linear speed, V_R , is the resultant of present instantaneous linear speed V and motion due to ‘central force’ u .

In both cases, deflection rate W is equal to drifting rate $-\alpha$, and the direction of resultant linear speed PP_1 is along tangents XX at the point of entry. Hence, the present drifting rate $-\alpha$ is the highest angular speed for any prospective planetary body. Only those macrobodies, approaching with an angular speed less than $-\alpha$, can form a stable orbital path about the central body.

When the resultant linear speed of the planetary body, V_R , is along the tangent to the datum orbit at the point of entry, the deflection rate W is just sufficient to overcome the outward drifting rate α . $W = -\alpha$.



From figure 7,
$$\sin W = \frac{AP_{\perp}}{PA} = \frac{u}{V} = \sin(-\alpha)$$

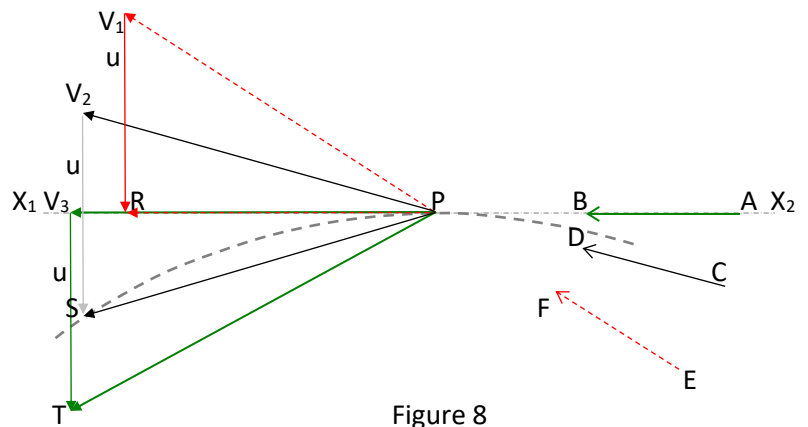
Highest permitted drifting rate, $-\alpha = \sin^{-1} \frac{u}{V}$ radian (12)

Equation (12) gives a higher limit of (outward) drifting rate at the point of entry for a macrobody, which approaches the datum orbit from within and may enter into a successful orbital path about a central body. Macro bodies, approaching the datum orbit from within, which have a greater outward drifting rate than this value, will fly away from the central body.

Equation (5), $-\alpha = \sin^{-1} \frac{u}{2V}$ radian, gives condition required for an orbiting planetary body to have periapse and apoapse in its orbital path. This equation should be satisfied two times in every completed cycle (apparent orbit) of the orbital path. If planetary body is entering its datum orbit from outside, by the time it reaches its periapse, drifting rate of planetary body should attain a value of $\sin^{-1} \frac{u}{2V}$. As long as this value is not reached, the planetary body will continue to move towards periapse in its orbital path. That is, the distance between central and planetary bodies continues to reduce until the planetary body reaches periapse in its orbital path.

Should drifting rate exceeds the value of $\sin^{-1} \frac{u}{2V}$, planetary body will move presumably towards periapse in its orbital path. However, if the drifting rate is greater than the value required for a stable orbital path, the planetary body will move towards the central body at a higher rate and spiral down into it, without ever attaining the condition required to reach the periapse. Even if a planetary body were to enter the datum orbit at the point of periapse, its drifting rate should not exceed this limit. Thus, $\sin^{-1} \frac{u}{2V}$ is the outer limit of drifting rate during entry (for a planetary body entering datum orbit from outside) to form a stable orbital path about a central body.

Figure 8 shows the angular limits of a planetary body's approach to its datum orbit. The grey dashed curve shows part of the datum orbit, near the point of entry of the planetary body. Only one possible point of entry on the outer side of the median path is discussed. The point of entry on the inner side of the median path is also similar.



Point P is the point of entry of the planetary body in the datum orbit. Central line X_1X_2 is tangent to the datum orbit at the point of entry. Directions of the planetary body's approach along arrows AB, CD and EF are shown in Figure 8. The present instantaneous linear speeds of macrobodies are shown by arrows PV_1 , PV_2 , and PV_3 in magnitude and direction. Arrows V_1R , V_2S and V_3T show radial linear speeds, u , of the macrobodies due to the 'central force'. Considering the parameters of approaching macrobodies are identical and

the parameters of the central body do not change, magnitudes and directions of u are identical. Resultant linear speeds of macrobodies are shown by arrows PR, PS, and PT.

Macrobody, approaching in the direction of arrow EF, has an outward drifting rate equal to angle V_1PX_1 . Part of the 'central force' acts in opposition to the macrobody's linear speed, and the resultant linear speed is reduced to PR. Macro bodies, which have a greater outward drifting rate than angle V_1PX_1 , will fly away from the central body. For a greater drifting rate, the reduction in resultant linear speeds will be larger. Unless the approaching linear speed is very high, the macrobody will be retarded sufficiently to return it towards the central body and fall into it.

A macrobody, approaching in the direction of arrow CD, has an outward drifting rate equal to angle V_2PX_1 . This is the lowest limit of outward drifting rate for a macrobody approaching datum orbit from within and the highest limit of outward drifting rate for a macrobody approaching datum orbit from outside. Magnitudes of drifting rate, lower than this value, are for those macrobodies approaching the datum orbit from outside. Therefore, the direction of the arrow CD is the border between approach angles for the macrobodies from within and without the datum orbit. All macro bodies approaching in the directions between arrows EF and CD can form stable orbital paths about the central body, by proceeding towards their apoapse.

For macrobodies approaching in the direction of arrow CD, the present linear speed and resultant linear speed are equal in magnitude. Radial motion of the macrobody is used solely to change its direction of motion. Macrobody will trace semicircular orbital paths, alternately on either side of the median path (circular apparent orbit).

A macrobody, approaching in the direction of arrow AB, same as tangent X_1X_2 at point of entry, has an outward drifting rate equal to zero. This is the lowest limit of outward drifting rate for a macrobody approaching the datum orbit from outside. Part of the radial motion is used to increase the resultant linear speed, PT. Macro bodies approaching the datum orbit between directions of arrows CD and AB (from outside the datum orbit) may form a stable orbital path about the central body by proceeding towards their periapse.

A macrobody, approaching the datum orbit with a negative drifting rate (inward deflection from tangent), cannot form a stable orbital path about a central body. It will spiral down into the central body.

Considering the above limits together, to form a stable orbital motion about a central body, a planetary body has to enter its datum orbit with values of drifting rates between $\sin^{-1}(u \div V)$ and zero. Angles, between $\sin^{-1}(u \div V)$ and $\sin^{-1}(u \div 2V)$ are for those macrobodies, which are approaching the datum orbit from within. Angles, between $\sin^{-1}(u \div 2V)$ and zero are for those macrobodies, which are approaching the datum orbit from outside.

Planetary bodies with (an outward) drifting rate between $\sin^{-1}(u \div V)$ and $\sin^{-1}(u \div 2V)$ have their aphelion in front of the entry point. When the (outward) drifting rate is equal to the critical value $\sin^{-1}(u \div 2V)$ (when the magnitude of resultant linear speed is equal to the magnitude of the present linear speed), the planetary body traces semi-circular orbital paths on either side of the median path.

Planetary bodies with (an outward) drifting rate between $\sin^{-1}(u \div 2V)$ and zero have their periapse in front of their point of entry. Limits between $\sin^{-1}(u \div 2V)$ and zero are for those macrobodies approaching from outside the datum orbit. From point of entry, they can move only towards periapse of their orbital path.

These stringent restrictions, in conjunction with restrictions on direction of approach (as explained in the next sub-section on 'Orbits about moving central body'), considerably lower the number of macro bodies, which are able to form stable orbital paths, and prevent profusion of planetary bodies about a central body.

The curvature of the orbital path and the tangential speed of a planet, at any time, depend on its location on the orbital path. The center of curvature at any point on the orbital path is its focus. In real orbital motion, the centres of curvature for alternate half cycles of orbital motion lie on opposite sides of the median path. The magnitude of the orbital path's curvature is zero at mid-points and increases as the planetary body moves towards

periapse or apoapse. However, while considering apparent orbit, an imaginary curved orbital path is assumed to close in on itself to provide a circular or elliptical nature.

A planetary body, approaching its datum orbit from outside, approaches on the convex side of the orbital path. Hence, it is not possible for this planetary body to enter its datum orbit within angles between $\sin^{-1}(u \div 2V)$ and zero to the tangent to the datum orbit during its first entry. Practically, a planetary body has to cross the datum orbit to reach the point of entry.

Orbits about a moving central body:

It is unlikely that macrobodies of considerable size move away from a central body to enter into an orbital path about it. All larger macro bodies, like planets, have to come from outside the planetary system. Planets could enter into orbital paths in any direction around a static central body. However, if the central body is moving (as is the case with all natural macrobodies), the directions of approach of their planets are restricted. The following description is about planetary bodies approaching a central body from outside their datum orbits. It is quite practical that many planetary bodies approaching a central body from outside their datum orbits may have to cross part of their datum orbit before their entry into the orbital path. That is, instead of approaching the point of entry directly, they may have to enter a datum orbit first, and then on their way out, they reach the point of entry proper. Somewhat similar conditions are applicable to planetary bodies that may approach the datum orbit from within. For a simpler explanation, the apparent orbit is used as a reference, and the real orbital path is compared with it later.

All large macrobodies, in space, move at very high linear speed. (It is estimated that the sun moves in a circular path around the galactic center at a relative speed of about 250000 m/sec, much greater than the relative speed of Earth with respect to the sun, which is about 30000 m/sec, in its orbital path about the sun). Relative speed between the central body and a planetary body trying to enter into an orbital path about the central body depends on the relative directions of their linear motions, with the limitation that the linear components of motion of both macrobodies are always in the same direction.

Planetary bodies approaching a central body in the opposite direction to its linear motion will find that the action of the 'central force' is to enhance their present linear speeds. The relative speed of macrobodies becomes too large for them to form a planetary system. Consequently, no macrobody that is approaching a moving central body in the opposite direction to the central body's linear motion can enter into a successful orbital path about the central body.

Similarly, macro bodies approaching from the sides (all around) of a moving central body will be left far behind. Such macrobodies have very little or no linear motion in the direction of the linear motion of the central body. Hence, their relative speeds are too large to be controlled by a relatively small 'central force'. They cannot form stable orbital paths about a moving central body.

To enter into a successful orbital path about a moving central body, a planetary body has to approach the central body from the rear and nearly in the orbital plane, at a linear speed greater or lesser (within a very small margin) than the linear speed of the central body. During their approach, the relative speed of a planetary body varies only by a small fraction with respect to the central body's absolute speed.

All macro bodies, in a galaxy, move in curved paths around the galactic centre. Directions of their linear motions may be modified slightly by gravitational interactions with other macro bodies in the galaxy. A central body usually has a curved path as shown by line NOM in Figure 9, where the direction of approach of a planetary body is shown with respect to its apparent orbit, prevailing at the time of the planetary body's entry into the orbital path.

A planet approaching its datum orbit from inside a curved path, NOM, will find that it has an additional relative motion away from the galactic center. This is produced by the curvature of the central body's path. The planetary body's drifting rate is enhanced by the curvature of the central body's median path. Additional relative motion enhances radial motion produced by the 'central force'. These factors prevent a macrobody, approaching from the concave side of the central body's path, from entering into a successful orbital path (about the central body that itself is moving in a curved path).

The above-mentioned factors leave only two small windows, shown by APEC and aQec in Figure 9 (widths of windows shown are highly exaggerated), through which a planetary body may enter into a successful orbital path about a central body. As the central body is assumed static, similar windows could be anywhere around the apparent orbit. Hence, we shall limit discussion only to one window APEC on the outer side of the central body's path NOM. This window is on the outer (convex) side of the curved path, NOM, and to the rear of the central body. Window, APEC, in 3D space, is somewhat conical in shape, with its apex towards the outer datum point in the planetary body's orbital path. The girth of the conical window restricts entry to those macrobodies whose orbital plane can be gradually stabilized into the central body's orbital plane. A similar window, aQec, available on the opposite side of apparent orbit is described later with respect to the real orbital path.

All macrobodies entering into successful orbital paths about a central body enter through this window. Entry is further restricted by limits on the rate of a planetary body's angular speed during entry. Therefore, there are no planets orbiting in the direction opposite to the central body's own orbital motion around the galactic centre or having their orbital plane too far from the central body's orbital plane. The direction of displacement of the apparent orbit of a planetary body is the same as the direction of the central body's orbital motion about the galactic center. Thus, all orbiting planetary bodies in a planetary system move in the same apparent angular directions and in planes not much different from the central body's orbital plane.

As shown in Figure 9, O is the center of the datum orbit around a (static) central body. The circle in the green line, PFQHP, is the datum orbit corresponding to central and planetary bodies' parameters at the instant when the planetary body enters the datum orbit. Datum orbit is the smallest possible circular apparent orbit suitable to the parameters of the central and planetary body, when the magnitude of the outward drifting rate is half the magnitude of the inward deflection rate. The black circle at O is the central body, and the black circle at D is the planet at its periapse. Elliptical figure, DGRKD, in dashed line is the planetary body's apparent orbit, corresponding to the position of the central body at O.

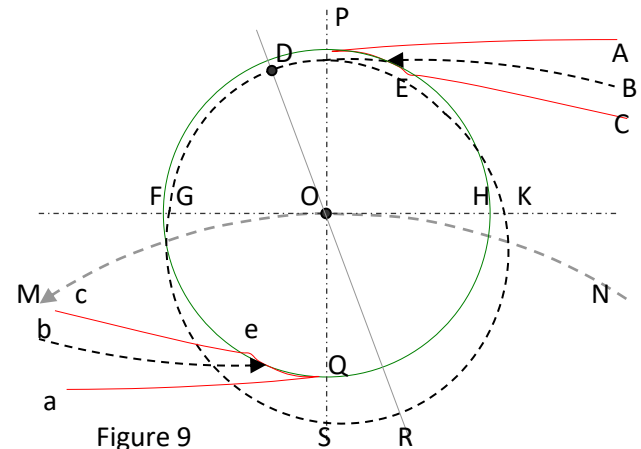


Figure 9

P and S are datum points, where the highest and lowest linear speeds of the planetary body occur. D is periapse, and R is apoapse of the orbital path, shown on the apparent orbit. Extension of line, POS, joins the central body with the galactic centre. At any instant, datum points, central body, and galactic centre are situated on line POS. Curved arrow, BE, shows the direction of linear motion of the planetary body while it is entering the datum orbit corresponding to apparent orbit DGRKD. A planetary body may enter into its datum orbit through the conical window shown by the region between A and C (shown in the plane of the paper by the space between APEC).

Relative position of periapse on apparent orbital path, D, depends on location of point of initial entry, E, and magnitude of drifting rate. The greater the drifting rate, the farther from the point of entry the periapse. The location of the apoapse is always diametrically opposite on the apparent orbit. The distance between the central and planetary body is least when the planetary body is at periapse, and it is highest when the planetary body is at apoapse. The linear speed of a planetary body is fastest when it is near the outer datum point, P, and it is slowest at point S (shown on the apparent orbit), when it is near the inner datum point, Q.

Only those macrobodies, approaching from outside the datum orbit, whose outward drifting rate at the time of entry into the datum orbit is within limits; $0 < \alpha < \sin^{-1}(u \div 2V)$ and whose direction of entry is through the permitted windows can produce stable orbital paths about the central body that is itself moving in a curved path. Changes in the rest mass or linear speed of an orbiting planetary body may change the size of its orbital path but not its eccentricity and angular position. In order to change the eccentricity or relative angular position of the

apparent orbit, separate external effort has to act on the orbiting planetary body to deflect it from its course and change the deflection rate of the instantaneous present linear speed, V , while moving in a stable orbital path.

Figure 10 shows entry zones for planetary bodies on their real orbital paths. Both windows of the entry are depicted in the figure. Thick dotted arrow NOM represents the path of the central body. Wavy arrow KDQK represents one full cycle of the real orbital path of a planetary body about the central body, moving along the median path NOM. Part KD of the orbital path, shown in dotted line, represents the extension of the orbital path before the point of entry to show one full cycle.

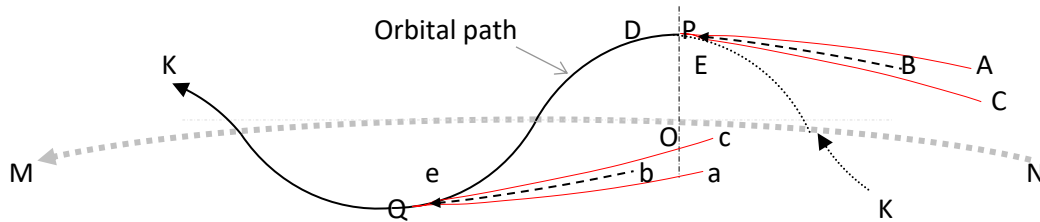


Figure 10

Entry zones are represented (in the plane of paper) by regions between APEC and aQec. Arrows BE and 'be' represent the directions of approach of a macrobody that may become a successful planetary body about the central body that is moving along the median path NOM. This figure may be compared with Figure 9. The description of the window aQec is also similar to window APEC, given above.

When Figure 10 is used to depict the real orbital path of a planetary body, instead of its apparent orbital path, as is used presently, it is clearly evident that a planetary body approaching a central body from any quarters other than through the entry windows APEC and aQec cannot enter into a successful orbit about the central body. Entry window APEC is outside the apparent orbit of a planetary body. Entry window aQec could be represented on the (opposite side) outside the apparent orbit, but in the opposite direction. Therefore, it is not described, as shown in Figure 9.

Hence, all macro bodies entering into stable orbital paths about a central body have to come from outside the planetary system. Unlike planets, comets have very large and highly eccentric apparent orbits. Their periape occurs within the central body's curved path, and their highest absolute linear speed occurs nearer to their apoapse. Hence, it may be deduced that they enter their orbital paths from within their datum orbits.

Anomalies:

Ideal cases of orbital motions of a planetary body and its central body are considered in the above explanations. However, in space, there are many macro bodies in the vicinity of a planetary body, and none of them are in a steady state of motion or without translational motion. Orbital motion of a planetary body is affected by nearby macro bodies and their motions. These effects usually produce what may appear as anomalies in the orbital motions of a planetary body with respect to its central body. Mostly, a central body may have a number of planets, each one with its own satellites. Additionally, there may be macrobodies, occasionally visiting planetary systems. All these macro bodies affect the orbital paths of all planetary bodies in a planetary system.

Many anomalous behaviors are noticed during observations of orbital motions in cosmology, with respect to apparent orbits of planets, satellites, and artificial satellites. Explanations, usually given, on these anomalies are based on the rationale of apparent planetary orbits around static central bodies, in conjunction with currently used illogical assumptions. Current laws of (empirically determined) planetary motion are also based on apparent orbits. Explanations, based on planetary laws devised for apparent orbit, are often too complicated and illogical. On many occasions, they fail to provide convincing arguments.

It should be noted that apparent orbit is an imaginary construct, devised solely for the purpose of finding relative positions of planets in a planetary system with respect to its (presumably static) central body. It cannot give accurate information on any phenomenon related to orbital motion, except for the relative positions of macro bodies in a planetary system. A small macrobody (artificial satellite), within a planetary system, that approaches or

leaves an orbiting planet cannot be expected to behave in a manner that satisfies laws of planetary motion devised for finding relative positions of planets with respect to a static central body.

From the time an artificial satellite leaves Earth (Earth's matter-field) it is not linked to earth any more. It acts as a free macrobody orbiting about the galactic centre, with its intrinsic motions, gained from the motion on Earth. Perturbations to its path due to the proximity of Earth may have an appearance that it is orbiting around the Earth. This is only in appearance. Hence, the relative linear speed of an artificial satellite may have apparent accelerations or apparent retardations, when it is related to the Earth, which itself is orbiting about sun.

A macrobody, trying to leave a planetary system, has to do so behind the rear of the central body. If it tries to leave the planetary system in a forward direction, gravitational attraction towards the planetary system will retard and slow down its linear speed. At the same time, due to the very high linear speed of the central body, the distance between the central body and the macrobody will reduce at a very high rate. If a macrobody tries to leave a planetary system in a direction perpendicular to the direction of linear motion of the central body, it will soon be left behind due to the very high linear speed of the central body. As this macrobody is not moving in an orbital path, it is not bound by the laws of planetary motion. Paths of such macrobodies, determined according to laws of planetary motion, may show discrepancies.

Depending on the locations of artificial satellites, the sun, and the earth in their respective real orbital path, the linear speed of an artificial satellite could apparently increase or decrease when observed from the earth, without external causes. These phenomena are quite logical, and there are no mysteries about them. There are no puzzling actions or anomalous effects. There is no increase or reduction in (kinetic) energy associated with them. Many of the apparent anomalies with respect to the motions of artificial satellites will vanish if the geometry for real orbital motion about a moving central body is used instead of the geometry for apparent orbit around a static central body.

Another fallacy, often discussed, is the multi-body problem, in light of various theories and laws related to apparent orbits. To define an apparent orbit, a static central body and a moving planetary body are essential. If there are only two macro bodies in consideration, one of them can be considered as a static central body and the other as a moving planetary body. However, if there are more than two macrobodies in consideration, in the same problem, the essential requirement of apparent orbital motion (one static macrobody and one moving macrobody) cannot be fulfilled. It is impossible for at least two macro bodies in a three-body problem to behave as static as well as moving entities at the same time, in the same problem. This is the conundrum required to sustain the multi-body problem, alive.

Apparent loss of orbital motion:

While a planet is performing its orbital motion about a central body, it is also orbiting around the centre of the central body's orbit (the galactic centre). Galactic centre is a static point in space, around which constituent macrobodies of the galaxy revolve. Consider a planetary system as a single unit (of revolving macrobodies about a central body) that is orbiting around the galactic centre. Stable galaxies are static spinning bodies, but they have no orbital motion about any other macrobody.

We shall consider the apparent orbit of a planet around its central body. Let the planet maintain a steady relative position with its central body. Similarly, let the central body maintain steady relative orientation with the galactic centre. A point on the surface of the central body is always facing towards the galactic centre. These conditions make it essential for the central body to spin once every revolution around the galactic centre. However, as the point on its surface continues to face the galactic centre, an observer at the point does not notice the central body's spin motion.

Similarly, even when the central body completes one revolution around the galactic centre, the planetary body remains in the same relative position with respect to the central body. That is, a planetary body has no apparent orbit around a central body. Although no apparent orbital motion with respect to the central body is noticed, in real motion, the planetary body has completed one cycle of orbital motion in space around the galactic centre. Hence, the number of apparent orbits, completed by a planetary body about its central body, is one less

than the number of real orbital motions it has to complete during one revolution of the central body around the galactic centre.

By the time the central body completes an orbit around the galactic centre, every planetary body in the unit apparently loses one (cycle of) real orbital motion each, about the central body. This provides an apparent loss of one orbital motion to a planet. A planet apparently loses part of its apparent orbital motion about its central body at a constant rate.

By the same reasoning, a satellite of a planet loses one apparent orbit around its planet every planetary year. However, with respect to its real orbital motion, a satellite loses only one apparent orbit during its revolution around the galactic centre, which may take several planetary years.

Precession due to eccentricity:

If there is a large difference in the magnitudes of 3D matter-contents of the central body and the planetary body that has a highly eccentric apparent orbit, the difference between linear speeds of the orbiting planetary body, during its acceleration and decelerating stages in orbital path, is considerably large (efficiency of an external effort depends on the linear speed of a macrobody [1]). Difference in linear speeds influences actions by the 'central force' on a planetary body. Such actions can apparently rotate (precess) the apparent orbit without changing its shape or size. Rotation of apparent orbit means forward or rearward shifting of the real orbital path of a planetary body in relation to the central body's location on the median path.

In real orbital motions, both central and planetary bodies move about the same median path. Perturbations of a planetary body's path are more apparent, and the perturbed path appears as its real orbital path. While a planetary body is moving along with the central body, it is in front of the central body for half its orbital period (during its motion from outer datum point to inner datum point), and it is behind the central body for the next half of its orbital period (during its motion from inner datum point to outer datum point). When a planetary body is in front of the central body, the 'central force' acts to decelerate it, and when a planetary body is behind the central body, the 'central force' tends to accelerate it. (Actions by 'central force' on central body are of opposite natures).

Inertial actions are slower and hence less effective when external efforts are in the direction of motion of a macrobody. Consequently, it takes longer for a planetary body to traverse its real orbital path from the inner datum point to the outer datum point, compared to the other half. A longer time period causes larger radial displacement of the planetary body, taking it nearer to the median path (during its travel from the inner datum point to the outer datum point). The planetary body's perpendicular distance from the median path during this period becomes shorter than its distance in the opposite direction during the next half of the real orbital path. The difference between the distances from the median path provides a resultant displacement of the real orbital path towards the centre of the central body's path (galactic centre). A planetary body, in its path, is displaced nearer to the centre of the central body's path (galactic centre).

Unlike in an elliptical apparent orbit (which has two foci), an oval apparent orbit has only one focus. The central body is located at the focus of the oval apparent orbit. Consequently, there is only one point in apparent orbit that is nearest to its focus. This point is called periapse. If the apparent orbital path of a planetary body is displaced, such that another point in the orbital path comes nearest to the focus, the effect is as if the periapse of the apparent orbit has shifted to a new location.

As different points on apparent orbit come nearest to the central body, on successive apparent orbits, the periapse shifts along the apparent orbit. Continuous displacement of periapse appears as a rotation of the apparent orbit of the planet around the central body, with respect to the (static) central body. Displacement of the point of perihelion gives rise to the apparent phenomenon of 'precession' of the orbit. Orbital precession is an illusion provided by the displacement of the 'point of nearest approach' of the central and planetary bodies. In reality, no changes take place in the relative motions of planetary bodies, except that the periapse (point in space at which central and planetary bodies come nearest) shifts along the perturbed path of the planetary body. Magnitudes of perturbations to orbital path or their time periods are not affected.

If orbital motion is considered with respect to a planetary body (central body orbiting a planet), the orbit of

the central body appears to precess in the opposite direction with respect to the planetary body. Apparent orbits of all planetary bodies with highly eccentric orbits have appreciable precession about their central bodies. In case of a central body, having two or more planetary bodies in highly eccentric apparent orbits around it, the central body will have different rates of precessions simultaneously; a different rate of precession with respect to each of the planetary bodies. This is an impossible situation if the precession is linked to the real motions of the planets. The direction of this precession is the same as the direction of motion of the planet in its apparent orbit.

Assorted perturbations:

Wandering macrobodies in open space may fall into planetary bodies or into the central body during their attempt to form orbits about either of them. A foreign macrobody, falling in, brings in additional 3D matter-content and additional work associated with it. Such additions are likely to modify the orbital parameters of planetary bodies in a planetary system. Over an extended period in space, modifications of the orbital properties of planets are very probable due to collisions with other macrobodies.

Orbital motions of planetary bodies are also influenced by nearby macro bodies. These changes may be either temporary or permanent. Very large differences in orbital properties of a planetary body may cause its gradual displacement towards another planetary body in the same planetary system and result in their collision. An accurate picture of planetary orbital motion can be developed only when all other macrobodies in space are considered.

Once the steady state of a planetary orbit is established, it will maintain its constant parameters unless affected by external influences. Planetary bodies can neither change orbital linear speeds nor change the distances towards the central body. As there is no direct physical link between the planetary bodies and the central body, additional work (energy) associated with any one of them cannot be transferred to another.

All apparent inconsistencies in planetary orbital motion are created by using apparent orbital paths around a central body rather than real orbital paths about a central body in space. If we consider the Sun as a moving macrobody, most anomalies (stellar aberration, Pioneer anomaly, multi-body problem, etc.) in cosmology, in and around the solar system, may disappear.

Conclusion:

Elliptical/circular planetary orbits around a central body are apparent geometrical structures, developed from relative considerations and the appearance of planetary motions to an observer (assumingly) based on the static central body. They are created to explain relative positions and observed movements of planets about a static central body. We can predict certain cyclic phenomena from apparent orbits. However, they do not provide logical and physically correct explanations for many phenomena. In reality, a planet moves along with the central body in a wavy path about the median path of the planetary system around the galactic centre, alternately moving to the front and rear of the central body. A planetary body enters into its orbital path straightaway as it approaches the central body; there is no gradual development of orbital motion. All planets and satellites in a planetary system orbit in the same direction, which is the same as the central body's orbital path about the galactic centre. The direction of entry of the planetary bodies is limited through two extremely small regions. In order to enter a successful orbital path, a planetary body has to approach the central body in an (almost) parallel direction to its path at the right distance away and from the rear of the central body. The right distance is determined by the linear speed and 3D matter-content of the planetary body.

Reference:

[1] Nainan K. Varghese, *MATTER (Re-examined)*, <https://www.matterdoc.in/>

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