ESSAY 79 : The Kinematics of Planar Orbits

The study of orbits is one of the oldest parts of science and reached a peak of achievement when Kepler inferred that the orbit of Mars is an ellipse - or so he thought at the time. It is in fact a precessing ellipse. The latest papers of the internationally acclaimed UFT series develop the kinematics of planar orbits on the classical level. This is a very simple and powerful method applicable to all planar orbits observed in astronomy. The method simply calculates the velocity and acceleration from the position vector. In Cartesian coordinates this is a matter of straightforward differentiation with fixed coordinates. The coordinates in a plane polar system are however rotating in a plane, and that introduces a lot of new information which can explain the main features of all planar orbits observable by astronomy. The rotation of the axes means that there is present a geometrical connection. For planar rotation the connection is the angular velocity, a simple inference which makes classical dynamics a part of the ECE theory. The ordinary derivative is replaced by a covariant derivative in the presence of a connection. In differentiating the position vector in plane polar coordinates the radial unit vector of the plane polar system must be differentiated with respect to time, and this process defines the spin connection. It results in a velocity that consists of two terms, one inertial and one orbital. Both are real and physically measurable in the laboratory frame of reference. The orbital velocity is the cross product of the angular velocity vector and the position vector. This can be seen in any textbook, but the new inference is that it is due to the spin connection of Cartan.

Continuing this process, the acceleration is calculated in plane polar coordinates and is found to consist of several terms. These can be described as inertial, centrifugal and Coriolis. These accelerations are all real and physically measurable. The Coriolis acceleration consists of two terms, and the centrifugal acceleration is the cross product of the angular velocity and the orbital velocity. For all planar orbits, of any kind, the Coriolis acceleration vanishes, and the centrifugal acceleration is the same for all planar orbits. These two facts of planar orbits were discovered in the latest UFT papers. Before that, planar orbital theory was narrowly constrained to Newtonian theory with small corrections due to Einstein - or so it was thought.

It is now known and accepted that neither Newton nor Einstein were right.

The force is defined as the acceleration multiplied by the mass m of the orbiting object and the force needed to keep m in any planar orbit is always the sum of that due to the inertial acceleration and centrifugal acceleration. The inertial acceleration is different for each type of planar orbit and so there is no universal acceleration, no universal force, and no "universal gravitation". The centrifugal force is inwardly directed to balance the outwardly directed force of the object m as it tries to escape the orbit. An easily understandable analogy is the discus or hammer thrower in athletics.

The Newtonian theory is constrained to an elliptical orbit. In this case the inertial force consists of two terms. By accident, one of these inertial terms cancels the centrifugal term, leaving what looks like an inverse square law from the second inertial term. However, this is not the inverse square law of the textbooks, it is the result of taking an elliptical trajectory in kinematics and contains the half right latitude of the ellipse, denoted alpha. The inverse square law of the textbooks is always the negative of m multiplied by MG, and divided by the square of r. Here M is the mass of an object such as the sun located at the focus of the ellipse, G is Newton's constant, and r the magnitude of the position vector, i.e. the distance between m and M. The inward force generated by an elliptical orbit becomes the Newtonian inverse square law if and only if alpha is chosen in a particular way in order to force one law to become the other, different, law. The Newtonian inverse square law was in fact discovered by Robert Hooke, and is a purely inertial force without any consideration of the centrifugal force. This law describes the force between m and M on a laboratory bench, without any rotational motion. It is quite different from the force law from an elliptical trajectory, which by definition is rotational motion.

The great power of the kinematic method is that it can be used to calculate the force law for any planar orbit, not just an ellipse. For example the force law of a precessing ellipse calculated with the kinematic method is the sum of terms inversely proportional to the square and to the cube of r, and again contains the half right latitude. The force law for a hyperbolic spiral orbit is inversely proportional to the cube of r. The new kinematic method shows that the hyperbolic spiral orbit results in a constant velocity as r becomes infinite. This fact was discovered by astronomers in about 1960, and neither Newton nor Einstein can begin to describe it. The kinematic sub theory of ECE theory describes it perfectly and shows that the star emerges from the central part of the whirlpool galaxy.

So there was tremendous confusion in the way in which orbital dynamics used to be taught. The dynamics were wrongly explained by an artificially created centrifugal “pseudoforce” and “effective” potential needed to counterbalance the force of attraction of Robert Hooke, not Isaac Newton. In fact the only force present is the component of the inertial acceleration left after cancellation of two inverse cubed terms. The net force inward counterbalances the attempt of m to leave the orbit exactly as in the discus and hammer events in athletics and the net force inward is the only force present.