# A NEW KIND OF PERIODIC ORBIT : THE THREE-DIMENSIONAL ASYMMETRIC

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A great deal of human and computer effort has been directed in recent decades to the determination of the periodic orbits of the restricted three-body problem and the study of their properties for well known reasons of significance and feasibility.

In most cases it is the plane and symmetric (with respect to the synodical line of the primaries) orbits that are investigated the main reasons for this being simplicity of the algorithms involved and computer time economy. Few results exist on the three-dimensional symmetric periodic orbits and even fewer on the plane but asymmetric ones.

It is felt that our understanding of the structure of the periodic solutions of the restricted problem can be improved if more attention is paid to the asymmetric orbits. Not only are these orbits necessary in order to obtain a complete picture of the set of periodic orbits but they seem to be highly relevant in the study of the motions of the members of the Solar system, as they are characteristically associated with *commensurabilities*.

Clearly the most general orbits, and the most relevant ones in the study of the Dynamics of Planets and Satellites, are the *Asymmetric Three-Dimensional*. This note is an announcement of their discovery.

They have been detected by examination of the stability of plane asymmetric periodic orbits with respect to perturbations which tend to change the plane motion into three-dimensional. They have been determined numerically by application of a suitable predictor-corrector algorithm. Details are given in another paper.

Here we illustrate a family of asymmetric three-dimensional periodic orbits 'around' both primaries. The orbits shown are retrograde in the rotating, but direct in the fixed, system of coordinates. Their periods are nearly commensurate to the basic period of the system (twice as long). The value used for the mass parameter of the problem was $\mu = 0.45$.

*V. Szebehely (ed.), Dynamics of Planets and Satellites and Theories of Their Motion*, 315-317.

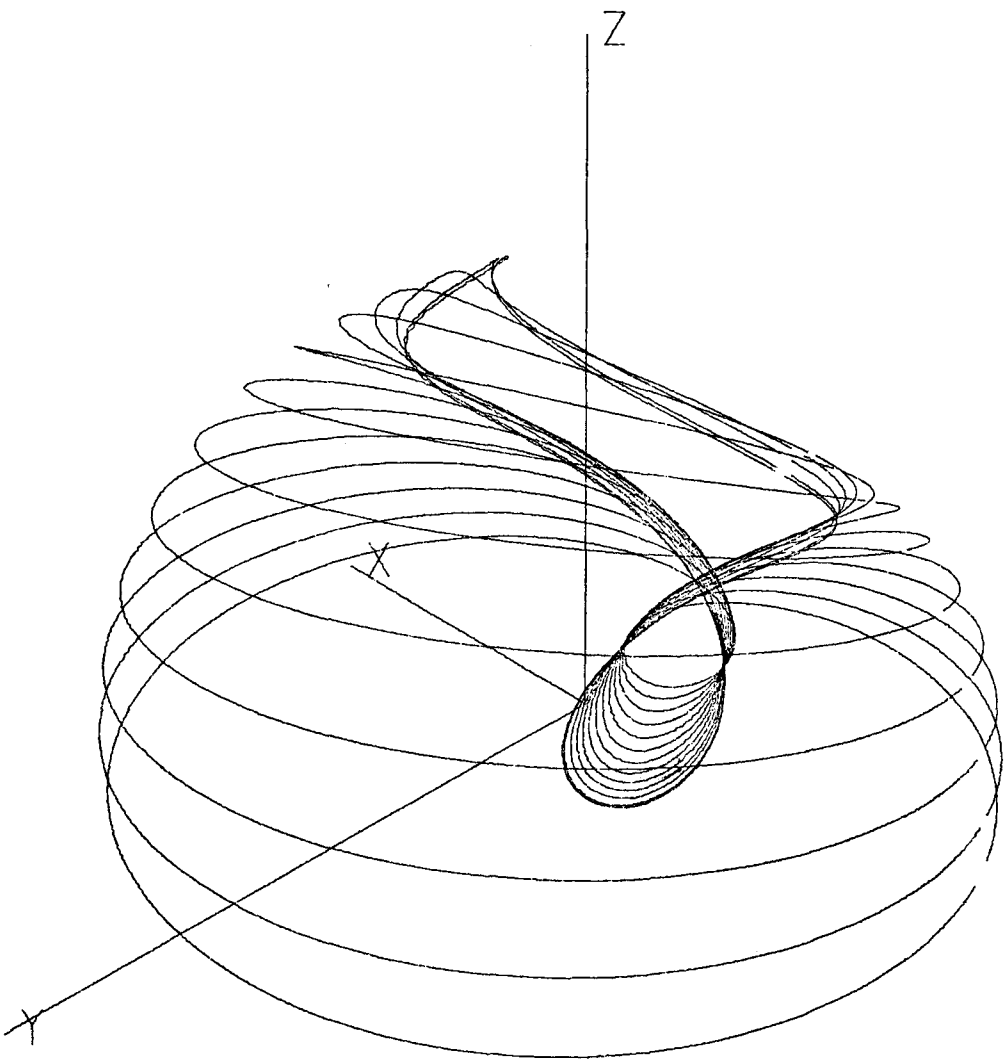


Fig.1 Computer plot of the family A2($\ell_2$) of three-dimensional asymmetric periodic orbits. The image is created by conical projection of the orbits on a plane perpendicular to the line joining the point of "view" (x= -3, y= 3, z= 3) to the centre of mass of the primaries (origin). The axes are drawn to distances three times the mutual (unit) distance of the primaries.

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This is the second of two families (A1($\ell_2$) and A2($\ell_2$)) that have been determined of this new kind. Both families bifurcate from family a($\ell_2$) of plane asymmetric periodic orbits. The latter family has been discussed by Kristianson (1933) and Message (1969). It is a branch of Strömgren's family $\ell$ of plane symmetric periodic orbits around both primaries.

## References

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