N BODIES - NOT A PROBLEM

by Karel Havel

Professional mathematicians agree that the unrestricted analytical solution of the classic n-body gravitational problem is impossible. They should know, because they tried to manipulate the Newton's Law of Gravitation for over 300 hundred years, in an effort to promote it to more than two bodies. In the process, they published several restricted solutions. However, the grand prize, the general unrestricted solution of the n-body gravitational problem, eluded them.

On the other hand, trillions of rocks are flying in space under the influence of gravitation for billions of years, without any problem. No rock ever complained that gravitation is impossible, which means that, for the rocks, the n-body gravitational problem is trivial. The rocks are not familiar with mathematics and cannot even count their numbers, which means that, for the rocks, the n-body gravitational problem does not exist.

The general unrestricted analytical solution of the n-body gravitational problem is disclosed in [1]. Even though it sells in bookstores, the book has been ignored so far.

To summarize:

- the n-body gravitational problem is impossible to solve;
- the n-body gravitational problem is trivial;
- the n-body gravitational problem does not exist;
- the n-body gravitational problem has been already solved;
- the solution of the n-body gravitational problem has been ignored.

Instead of trying to reconcile these incompatible views, I shall briefly explain how I solved the problem. I did it in two steps. The first step was to examine in detail how the rocks fly in space under the influence of gravitation. The second step was to convert the physical operation of gravitation to an analytical mathematical model.

Here is the mathematical model for three bodies under the influence of gravitation.

An unrestricted three-body gravitational problem can be defined as follows. Let the positions and velocities of the three bodies be given at an arbitrary time T_0. It is required to calculate the new positions and new velocities of the three bodies at a different time $T_0 + T$, where time increment T is arbitrary, either positive or negative.

The detailed equations for the unrestricted analytical solution of the three-body gravitational problem appear in [1].

In summary, the solution consists of nine equations for calculating at the new time, nine components of the new accelerations (a_{0X}, a_{0Y}, a_{0Z}; a_{1X}, a_{1Y}, a_{1Z}; and a_{2X}, a_{2Y}, a_{2Z}) of the three bodies, plus three extra equations for calculating three auxiliary variables, distances $d_{01} = d_{10}$, $d_{02} = d_{20}$, and $d_{12} = d_{21}$, from the values known at the initial time. There is the same number of equations as the number of the unknown variables. All these equations must be solved simultaneously.

There are nine more equations for calculating at the new time, nine components of the new velocities (v_{0X}, v_{0Y}, v_{0Z}; v_{1X}, v_{1Y}, v_{1Z}; and v_{2X}, v_{2Y}, v_{2Z}) of the three bodies from the values known at the initial time. All integrals in the equations are of the same type. There is the same number of equations as the number of the unknown variables. All these equations must be solved simultaneously.

There are nine more equations for calculating at the new time, nine components of the new positions (r_{0X}, r_{0Y}, r_{0Z}; r_{1X}, r_{1Y}, r_{1ZV}; and r_{2X}, r_{2Y}, r_{2Z}) of the three bodies, from the values known at the initial time. All integrals in the equations are of the same type. There is the same number of equations as the number of the unknown variables. All these equations must be solved simultaneously.

There are no restrictions, other than the trivial ones, on the initial values of the variables: the masses of the three bodies must be positive (and, of course, can be respectively different); no two bodies are allowed in the same position.

The solution of the n-body gravitational problem is also disclosed in [1].

[1] Havel, Karel. *N-Body Gravitational Problem: Unrestricted Solution* (ISBN 978-09689120-5-8). Brampton: Grevyt Press, 2008.

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