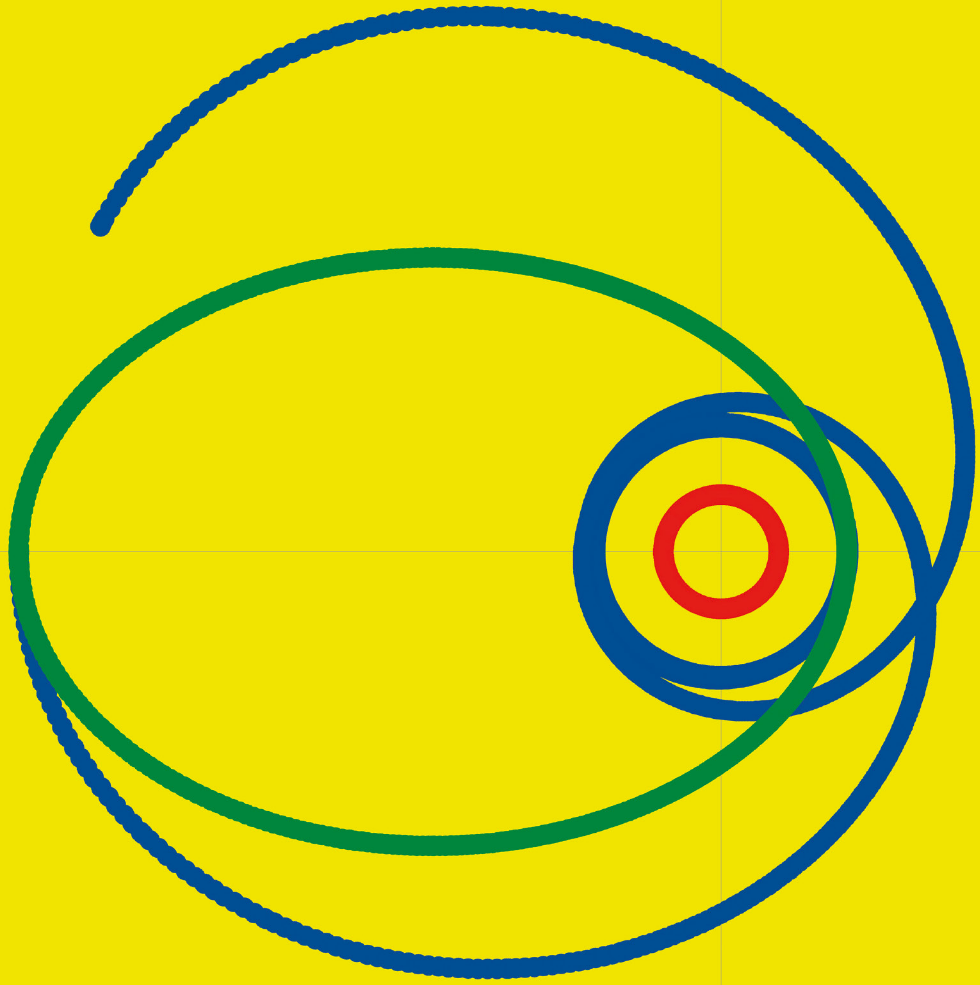

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Gravitation II – Relativistic planet orbit

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CONTENT

FOREWORD

This book constitutes the second part for reference /1/: 'Gravitation, Exact calculation of Newton and Einstein theory'. In that book the gravitation equations are solved in an unusual way. The equations of Newton theory are constructed in a reverse order. Starting point is the observed elliptic orbit of a planet and the theory is derived by demanding that the planet acceleration points to the Sun, which is located at one of the ellipse focal points. In this way one gets in an easier way the planet position as a function of time and also the speed and acceleration of the planet. These results are used as the starting point for the relativistic calculations.

In reference /1/ the relativistic planet orbit Euler equations are constructed in a different way compared to the normal method and the equations also are different from the normal Euler equations. The solutions of these equations in case of free fall and in case of two dimensional planet orbit calculation are the same as the solutions of the normal Euler equations. The Euler equations are solved by inserting a trial function, which is a sum of the corresponding classic solution and an unknown function. In this way you get such an equation for the unknown function that can be solved. This is probably a new way to solve the planet orbit according to relativity theory. Using this method only one integrations constant appears into the solution function of the planet orbit. If you solve the Euler equations in the normal way you get two integrations constant into the solution function.

The results presented in reverence /1/ constitute the starting point for the theory presented in this book.

Helsinki 28.2.2021 Uuno Kivi

1. INTRODUCTION

The Euler equations for the planet orbit constructed in reference /1/ constitute the starting point for the theory presented in this book. A practical method for planet orbit calculation according to relativity theory is developed in this book. There appears two integration constants in the orbit equations constructed in the literature. It doesn't seem to be easy to determine prober values for these constants. If you construct the Euler equations in the way presented in reference /1/ you don't get any unknown integration constants in the equations, if you make the solution for the angular speed so that it approaches the classical solution in the classical limit (speed of light $c \rightarrow \infty$). Mathematically there should be an unknown integration constant. In the equation for the angular speed you may multiply this constant into value for the half length of the orbit ellipse minor axis – b. In practice this constant had to taken in use in reference /1/, because you had to change the value for the minor axis to get the Sun to the same position in relativistic and classic solutions.

We proceed mathematically in a more accurate way in this book compared to reference /1/. We demand that the distances of the planet in perihelion and aphelion are the same according to relativity theory and according to classical mechanics and in this way we get equations for the integration constants as functions of perihelion and aphelion distances and Schwarzschild radius. One could also verify in this way that the correction for the half minor axis used in reference /1/ was quite accurate. This correction could be made in reference /1/, because the values for the major and minor axes are pure parameters in the relativistic solution without any geometric interpretation and the relativistic solution is not an ellipse although it is nearly an ellipse in a weak gravitation field. The minor axis half was increased in reference /1/ by 3018.779 m and the value of the major axis was not changed. In this way the Sun could be positioned with an accuracy of 0.4 mm into the same point in relativistic and classical solution. According to the more accurate solution presented in this book the minor axis half is increased by 3018.79877 m and the major axis half is increased by 0.00016 m. In this way the planet distances at perihelion and aphelion are exactly the same in relativistic and classical solutions.

Values for the integration constants in the relativistic orbit equation are constructed in this book as functions of Schwarzschild radius and the planet maximum and minimum distances from the Sun. An algorithm to calculate the planet orbit according to relativity theory is presented in the book. A computer program that uses the algorithm has been listed in an appendix. Eight different cases have been calculated; the sun or black hole mass has been varied in these cases. The orbit graphs are presented in figures. The perihelion shift is presented as a function of the polar angle coordinate in every suitable calculation case. The text has been clarified with more than 20 graphs describing the form of the planet orbit.

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