

REFERENCE FRAMES AND EQUATIONS OF MOTION IN THE FIRST PPN APPROXIMATION OF SCALAR-TENSOR THEORIES OF GRAVITY

Igor Vlasov

Dr. Sergei Kopeikin, Dissertation Supervisor

ABSTRACT

Post-Newtonian relativistic theory of astronomical reference frames based on Einstein's general theory of relativity was adopted by the General Assembly of the International Astronomical Union in 2000. This theory is extended in this dissertation by taking into account all relativistic effects caused by the presumable existence of a scalar field and parameterized by two parameters β and γ of the parameterized post-Newtonian (PPN) formalism. A Brans-Dicke type of scalar-tensor theories is used to work out PPN concepts of global and local reference frames for an isolated N-body system. The field equations are solved in the first PPN approximation in the global and local frames. A correspondence between the local and global coordinates is found by making use of an asymptotic expansion matching technique. This technique, along with multipole expansions of gravitational fields, allows to find a class of the post-Newtonian coordinate transformations between the frames as well as equations of translational and rotational motion of the center of mass of a member of the N-body system. As an illustration, the general method is implemented to the case of spherical bodies.