Public Abstract

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Title: Reference Frames and Equations of Motion in the First PPN Approximation of Scalar-Tensor Theories of Gravity

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 of the parameterized post-Newtonian (PPN) formalism. Modern gravitational experiments and all astronomical observations become more and more sophisticated and there is a need for processing algorithms which would be consistent with their rapidly growing precision. Testing the General Relativity theory is a very challenging but necessary for our understanding of nature task. It is widely accepted that Einstein's theory adequately explains gravitational phenomena but there is still a possibility that the theory is not exact. The classical PPN formalism was designed more than thirty years ago to treat other feasible theories of gravity on equal footing but many of its features do not satisfy demands of modern observations. This dissertation presents a formal theoretical approach to modification of PPN formalism in the case of the presence of one extra type of gravitational field - a scalar field. Different coordinate systems are introduced which can be used to describe the motion of such astronomical bodies as planets and satellites. The relation between these coordinates is obtained in the present work along with formulas of how a body moves under actions of other bodies and its own gravity. The results of the dissertation can be readily used for construction of consistent numerical algorithms for processing of experiments designed to test wether a scalar field exists.