ASTRONOMICAL MEASUREMENTS AND COORDINATE CONDITIONS IN RELATIVISTIC CELESTIAL MECHANICS

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ABSTRACT

The differences between the Newtonian theory and the general relativity appear both in the "relativistic effects," such as the advance of perihelion, and in the deflection of light beams that modifies the astronomic observations and the radar reflection measurements.

Determination of dynamical effects from the equations of motion and calculation of ephemerides in terms of measurable quantities on the basis of the equations of light should be performed in one and the same coordinate system. The choice of coordinate system is arbitrary. For illustration we consider complanar circular motions of the Earth and one of the inner planets in the solar gravitational field described by the generalized three-parametric Schwarzschild metric. Specific values of the metric parameters characterize just as adopted gravitational theory, so also a definite coordinate system (for example, isotropic or "standard" coordinates). Coordinates of the planets and radii of the orbits are coordinate-dependent quantities and cannot be directly reconciled with measurable quantities such as the round-trip transit times of radar signals or the angular distance between the planet and the distant fixed source (quasar). These ephemeris data may be calculated in terms of the initial measured values independently of the employed coordinate system. Relativistic ephemeris corrections should be taken into account both in radar reflection measurements and astrometric observations.

R. L. Duncombe (ed.), Dynamics of the Solar System, 95.