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Relativistic Effects in the On-Board Clocks of Navigation Satellites Moving in Near-Circular Orbits

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Abstract. The article is a continuation of the author's article on relativistic effects in quantum clocks in elliptical orbits [1]. Refined formulas have been obtained for calculating the relativistic effects of changes in frequency and time in satellite clocks located in standard GLONASS near-circular orbits, as well as in promising geosynchronous orbits. Frequency effects with a relative magnitude of more than 3·10-16, as well as relativistic shifts of onboard scales exceeding 25 picoseconds, are taken into account analytically. It has been established that, at the accepted level of accuracy, it is advisable to take into account the error of the currently accepted frequency correction of the on-board clock, the potential difference between the geoid and the position of the Central synchronizer, the difference in the size of the semi-major axis of the satellite and its average value for the entire satellite system, the influence of the second zonal harmonic of the Earth's potential, and also a component of the relativistic time drift, proportional to the second degree of eccentricity.

Keywords: relativistic effects, on-board time scale shift, gravitational frequency shift, quantum clocks, global navigation satellite systems

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