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AUTONOMOUS RADIO-PHYSICAL GRAVIMETER BASED ON FEMTOSECOND LASER

Abstract

With the development of ultrashort pulse lasers (at present time, as short as 5x10-15s), it become possible to study super-fast processes of the world around us, including that of the man-made. For the most observable temporal processes femtosecond pulses can be described best as the delta function. Femtosecond lasers have a great potential for use in metrology. The unique feature of super continuum generation in the regime of longitude modes self-synchronization, with the modes equidistance of at least 10–16, gives the ability to create the so-called, frequency "comb". Using this precision "comb", one can perform not only etalon synchronization at different frequencies, but, also, measure absolute value for optical frequencies. Another unique feature of femtosecond lasers is their use as driving oscillators together with the method of frequency-modulated pulses amplification for creating super high-power laser systems of terawatt (1012 W) and petawatt (1015 W) level — chirped pulse amplification laser systems. Such unique characteristics of the lasers make it possible to create an autonomous radiophysical gravimeter, which main concept of operation is to measure the frequency gravitational shift of the laser radiation. Since the relative displacement of the frequency of the electromagnetic radiation under the influence of gravitation is 10–15 per 1 m, which corresponds to the already achieved performance charasteritics of femtosecond lasers, therefore it become possible to create three-axis radio-physical gravimeter in the shape of cube, with the edge of not more than 1 m, the weight of not more than 30 kg and the power consumption of not more than 600 watts. Recently, a femtosecond laser, emitting at 800 nm with the pulse duration of 17.3 fs had been created at "The Institute of Plasma Electronics and New Methods of Acceleration" NSC KIPT. This laser system provides the basis for the radio-physical gravimeter development. The main

unique characteristics of the gravimeter are autonomy and persistence-free operation, the properties that the existing ballistic gravimeters lack. These features make the gravimeter a unique system for solving the problems of gravitational field parameters measurement for the planets of the solar system and deep space.