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NASA TECH BRIEF

Marshall Space Flight Center

Laser Interferometry Method for Absolute Measurement of the Acceleration of Gravity

A laboratory model of an absolute gravimeter can measure the acceleration of gravity, g, with a significantly greater accuracy than has previously been attained. Experiments with the developmental gravimeter indicate that, with certain refinements and error analysis, the Potsdam values, which had been established for g at various locations on the earth's surface, can be corrected by approximately 138 microns/sec^2. The new gravimeter has potential as a more accurate and precise instrument for the absolute measurement of g without reference to the Potsdam values as absolute standards.

The device is basically a Michelson laser beam interferometer in which one arm, designated the "bird," is a mass fitted with a corner cube reflector. During operation, the bird is released to fall freely under the acceleration of gravity in a hard vacuum. The monochromatic light beam, emanating from a helium-neon continuous-wave laser at a wavelength of 0.633 micron, is highly collimated, with a beam divergence of 10 mrad. A collimating lens is mounted on the laser to decrease beam divergence even further. A polarizing filter that can be adjusted for best interference-fringe contrast is positioned behind the collimating lens. The laser unit, which emits a power of 100μW, is controlled by a servo system and has a frequency stability of $\pm$ 1 mHz per day. The laser beam is projected through a beam splitter, which breaks the light into two beams, one beam going to the mirror on the freely falling bird and the other to a fixed front-surface mirror. The two beams are reflected from both mirrors back to the beam splitter, where they are superimposed and passed on to a photodetector. The interference fringes are detected by the photodetector, and the resultant output pulses are counted electronically. From these data, the distance fallen by the bird in a given time is ascertained, and the acceleration of gravity is easily computed.

Note:

The following documentation may be obtained from:

National Technical Information Service
Springfield, Virginia 22151
Single document price $3.00
(or microfiche $0.95)

Reference:

NASA-TM-X-53832 (N70-17316), Technical Documentation for the Mark I Model of the Laser Absolute Gravimeter

NASA-TM-X-53856 (N70-17389), Operation Manual for the Mark I Model of the Laser Absolute Gravimeter

NASA-TM-X-64503 (N70-35842), Gravity Gradient Measurements with a Laser Absolute Gravimeter

Patent status:

No patent action is contemplated by NASA.

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