Introduction to Gravity of Earth and Origin of Radiation

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Opinion Article

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ABOUT THE STUDY

Every planetary body is surrounded by its own gravitational field, which can be conceptualized with Newtonian physics as exerting an attractive force on all objects. Assuming a spherically symmetrical planet, the strength of this field at any given point above the surface is proportional to the planetary body's mass and inversely proportional to the square of the distance from the centre of the body.

The strength of the gravitational field is numerically equal to the acceleration of objects under its influence. The rate of acceleration of falling objects near the Earth's surface varies very slightly depending on latitude, surface features such as mountains and ridges, and perhaps unusually high or low sub-surface densities. For purposes of weights and measures, a standard gravity value is defined by the International Bureau of Weights and Measures, under the International System of Units (SI).

The force of gravity on Earth is the resultant (vector sum) of two forces; (a) The gravitational attraction in accordance with Newton's universal law of gravitation, and (b) the centrifugal force, which results from the choice of an earthbound, rotating frame of reference. The force of gravity is weakest at the equator because of the centrifugal force caused by the Earth's rotation and because points on the equator are furthest from the center of the Earth. The force of gravity varies with latitude and increases from about 9.780 m/s^2 at the Equator to about 9.832 m/s^2 at the poles. Canada's Hudson Bay has less gravity than any place on Earth.

Origin

The earliest gravity possibly in the form of quantum gravity, supergravity or a gravitational singularity, along with ordinary space and time, developed during the Planck epoch up to 10−43 seconds after the birth of the Universe, possibly from a primeval state, in a currently unknown manner.

Gravitational radiation

General relativity predicts that energy can be transported out of a system through gravitational radiation. The first indirect evidence for gravitational radiation was through measurements of the Hulse–Taylor binary in 1973. This system consists of a pulsar and neutron star in orbit around one another. Its orbital period has decreased since its initial discovery due to a loss of energy, which is consistent for the amount of energy loss due to gravitational radiation. This research was awarded the Nobel Prize in Physics in 1993.

The first direct evidence for gravitational radiation was measured on 14 September 2015 by the LIGO detectors. The gravitational waves emitted during the collision of two black holes 1.3 billion light years from Earth were measured. This observation confirms the theoretical predictions of Einstein and others that such waves exist. It also opens the way for practical observation and understanding of the nature of gravity and events in the Universe including the Big Bang. Neutron star and black hole formation also create detectable amounts of gravitational radiation. This research was awarded the Nobel Prize in Physics in 2017.