

## Gravity

Gravity is one of the four fundamental forces of nature. It is the dominant force in our everyday life and plays a vital role in the evolution of the universe. You might be surprised to learn that gravity may be described in terms of gravitational potential, generally referred to as gravitational potential energy, denoted by the Greek symbol  $\phi$ , phi. What is 'gravitational potential energy'?

Think about a river of which the mouth is frozen, preventing the water to flow into the sea. The water is subject to 'gravitational potential energy'. When the ice melts the water flows into the sea and the gravitational potential energy is converted into kinetic energy. Forces, such as gravity, always act in order to reduce the potential energy. This means that gravity is in the direction where the potential energy reduces the fastest.

This does not always apply, for instance, in the case of a planet in orbit around the Sun; the force is not directed at the centre of the planet. Rather the gravitational potential energy in the case of the planet is in fact a 'force' directed to the centre of the orbit, at right angles to the direction of motion.<sup>1</sup>) Note that, instead of referring to gravity as a force, it is more convenient to describe it in terms of *gravitational potential energy*.

Gravitational potential is widely used in astronomy and cosmology to indicate gravitational interactions. It is used, for instance, to describe the gravitational field of galaxies and clusters of galaxies to calculate the gravitational force in what is described as an 'N' body system ('N' is used to indicate the number of galaxies or clusters of galaxies). Such calculations are used to define the slight alterations in the density of the universe that gave rise to structures and, eventually, large scale structures in the evolution of the universe. It can, for

instance, be used to calculate the tiny anisotropies in the Cosmic Microwave Background Radiation, the seeds from which larger structures formed.

It is therefore correct to refer to gravitational potential energy rather than to refer to the gravitational force, a description we are so familiar with.

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