Relativistic Mass and Energy Encyclopedia Article

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The relativistic **mass** of an object refers to the measured mass of an object moving relative to the observer. A moving object appears to have a larger mass than the same object at rest. The mass of the object is directly related to its total **energy** according to Albert Einstein's 1905 publication on the theory of special relativity. The observed total energy of the moving object is called its relativistic energy.

The measured mass of a stationary object is called its rest mass. For an object with a rest mass m moving with a speed v, the observed mass of the object is found to be

where c is the speed of **light** in a **vacuum**, measured to be 186,000 mi/s (300,000 km/s). The total relativistic energy of the object is then given by Einstein's famous equation showing the equivalence of **matter** and energy:

As the object's speed increases, both the relativistic mass and energy of the object increase.

The energy associated with the object's **motion** is commonly referred to as **kinetic energy**, and the total relativistic energy of an object is the sum of the object's kinetic energy and its **rest energy**, $E=mc^2$. Therefore, the relativistic kinetic energy is the difference between the total relativistic energy and the rest energy. The deviation of the relativistic kinetic energy from Newton's kinetic energy is noticeable only for particles moving at a considerable fraction of the **speed of light**. For example, a particle moving with a speed equal to c/3 will be observed to have a relativistic mass that is 6% larger than its rest mass. Therefore, there will be a 6% deviation from Newton's kinetic energy formula.

The relativistic mass and energy of a particle must be considered in most modern elementary **particle physics** experiments, such as the experiments taking place at most particle **accelerators** like the one at the Fermi National Accelerator Laboratory in Batavia, Illinois, outside of Chicago.