Elementary Differences between Energy and Mass
(Draft)

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Abstract

In this paper I explain the elementary differences between energy and mass. When we consider the famous Einstein's formula $E = mc^2$ *these two concepts might look the same with the only differnce of a proportionalyty constant,* c^2 *, between them. However when we explore these two concepts more meticouslosly we discover that they differ in several aspects.*

Table of Differences between Energy and Matter

The following table shows the main differences between energy and mass.

	Energy	Mass
Maximum velocity (v_{max})	c	$< c$
Observers in relative motion will measure a velocity equal to	c (One of Einstein's postulates of SR)	$0 < v < c$
Time	does not elapse (photons do not "feel" time)	elapses
There is a fundamental relationship with	time $\Delta E \Delta t \geq \frac{\hbar}{2}$ (Temporal Heisenberg uncertainty principle)	space $\Delta p_x \Delta x \geq \frac{\hbar}{2}$ (Spatial Heisenberg uncertainty principle)

Origin	The Meta-Universe (always existed)	The Big Bang (had a beginning)
"Ingredients"	None. (Energy is primordial) $E = mc^2$ (Causes are on both sides of the equation)	Energy, space and time $m = \frac{E}{c^2}$ (Causes are on the second side of the equation only)

REFERENCES

[1] R. A. Frino, *Scale Factors and the Scale Principle*, viXra: 1405.0270, (2014).