

Spacetime Equals Mass Multiplied By Energy

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Abstract— It is a law that spacetime equals mass multiplied by energy. This law is scientific because it could be empirically tested. And it has a successful explanatory power, leading to its plausibility. For instance, it successfully explains the emergence of virtual particles from empty space due to its implication that all spacetimes, including empty spacetimes, are full of masses and energies. And, from the same perspective, it accounts for the existence of dark energy. An essential implication of the law spacetime equals mass multiplied by energy is the spacetime conception of the universe, according to which, spacetime configurations are the building blocks of the universe.

Keywords— Spacetime; Mass; Energy; Scientific Law; Virtual Particles; Black Holes; Dark Energy; Subatomic Particles; Universe

Introduction

It is a law of nature that $\text{spacetime} = \text{mass} \times \text{energy}$, i.e., spacetime is equal to mass multiplied by energy. This law has a successful explanatory power. And hence, it is a plausible law of nature in light of its success.

Virtual Particles

Virtual particles emerge from empty space and then disappear, such that the process of their emergence and disappearance is continuous [1]. The law $\text{spacetime} = \text{mass} \times \text{energy}$ is successful in explaining why empty space is full of virtual particles. Since $\text{spacetime} = \text{mass} \times \text{energy}$, it follows that all spacetimes, including empty spacetimes, contain mass and energy. And this is why empty space has mass and energy in the form of virtual particles.

Changing the Geometry of the Universe

If the geometry of our universe were to change, our universe would be a different universe. In other words, different geometries of reality lead to the occurrence of diverse universes [2]. The law $\text{spacetime} = \text{mass} \times \text{energy}$ successfully explains the previous fact. Given that $\text{spacetime} = \text{mass} \times \text{energy}$, it follows that if the geometry of spacetime were to change, then mass and energy would change, leading to the emergence of a different universe. This is how the law $\text{spacetime} = \text{mass} \times \text{energy}$ succeeds in explaining the fact that different geometries amount to different universes.

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Black Holes and Spacetimes

Anything which falls into a black hole vanishes and information is lost in black holes [3]. But the law $\text{spacetime} = \text{mass} \times \text{energy}$ successfully explains black holes in the following way: since $\text{spacetime} = \text{mass} \times \text{energy}$, it follows that when spacetime disappears, mass and energy will disappear as well, and hence, information (manifested in mass and energy) will be lost and black holes will be formed. This indicates that black holes are the absence of spacetimes. In other words, black holes are formed due to the absence of certain spacetimes in the universe which amounts to the absence of information, given that spacetime is information manifested in mass and energy.

Spacetime and Dark Energy

Dark energy is a repulsive force, causing the acceleration of the expansion of the universe. It is usually understood as the energy of empty space [4]. Now, the law $\text{spacetime} = \text{mass} \times \text{energy}$ successfully accounts for dark energy. And this success speaks for the plausibility of the previous law. Since $\text{spacetime} = \text{mass} \times \text{energy}$, it follows that all spacetimes, including empty spacetimes, are full of energy. And hence, energy exists in empty space. This shows that the law $\text{spacetime} = \text{mass} \times \text{energy}$ is successful in accounting for the existence of energy in empty space, which means that the previous law is successful in accounting for dark energy.

The Spacetime Conception of the Universe

Since $\text{spacetime} = \text{mass} \times \text{energy}$, while the universe consists of different masses and energies, it follows that the universe consists of different spacetime configurations. And therefore, spacetimes are the building blocks of the universe. This is the spacetime conception of the universe, according to which, all of the existents of the universe are diverse spacetime configurations.

From the previous perspective, all of the different masses and energies are different geometrical configurations of spacetime. This explains why gravity is a geometrical configuration, such as being the

curvature of spacetime, as Einstein said. Since all of the diverse energies are different geometrical configurations of spacetime, while gravity is a certain form of energy, it is natural that gravity is a specific geometrical configuration of spacetime, such as being the curvature of spacetime.

Subatomic Particles as Spacetime Configurations

According to quantum mechanics, the same subatomic particle, such as an electron, could exist in different places at the same time [5]. The law $\text{spacetime} = \text{mass} \times \text{energy}$ successfully explains the previous fact. Since $\text{spacetime} = \text{mass} \times \text{energy}$, while the universe consists of masses and energies, it follows that everything in the universe is a spacetime configuration, including subatomic particles. This shows that the law $\text{spacetime} = \text{mass} \times \text{energy}$ entails, and hence, leads to the spacetime conception of subatomic particles, according to which the diverse subatomic particles are different geometrical spacetime configurations. But if subatomic particles are geometrical spacetime configurations, then they are abstract entities, as any geometrical configuration is. And hence, the same subatomic particle, such as an electron, could exist in different places at the same time, as any abstract geometrical configuration could be instantiated in different places at the same time. This is how the law $\text{spacetime} = \text{mass} \times \text{energy}$ successfully explains the fact that the same subatomic particle could exist in different places at the same time.

The Emergence of the Universe

Given that $\text{spacetime} = \text{mass} \times \text{energy}$, while the universe consists of mass and energy, it follows that spacetime entails the existence of the universe. And hence, the universe emerged from spacetime. This is how the law $\text{spacetime} = \text{mass} \times \text{energy}$ explains the emergence of the universe.

A Scientific Law

The law $\text{spacetime} = \text{mass} \times \text{energy}$ is a scientific law of nature because it is falsifiable, i.e., it could be empirically tested. Since $\text{spacetime} = \text{mass} \times \text{energy}$, it follows that if there were a spacetime without containing mass and energy, then the law $\text{spacetime} = \text{mass} \times \text{energy}$ would be false. Hence, the law $\text{spacetime} = \text{mass} \times \text{energy}$ is falsifiable, leading it to be a scientific law.

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