Hawking radiation and the expansion of the universe

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ABSTRUCT

Based on Heisenberg's uncertainty principle it is concluded that the vacuum is filed with matter and anti-matter virtual pairs ("quantum foam") that pop out and annihilate back in a very short period of time. When this quantum effects happen just outside the "event horizon" of a black hole, there is a chance that one of these virtual particles will pass through the event horizon and be sucked forever into the black hole while its partner virtual particle remains outside the event horizon free to float in space as a real particle (Hawking Radiation).

In our previous work [1], we claim that antimatter particle has anti-gravity characteristic, therefore, we claim that during the Hawking radiation procedure, virtual matter particles have much larger chance to be sucked by gravity into the black hole then its copartner the anti-matter (anti-gravity) virtual particle.

This leads us to the conclusion that hawking radiation is a significant source for continuous generation of mostly new anti-matter particles, spread in deep space, contributing to the expansion of space through their anti-gravity characteristic.

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Key Words: matter, anti-matter, gravity, anti-gravity, gravitational blue shift.

1. Introduction

Matter and antimatter pairs were originally produced, based on the "big bang" theory, by pure energy ($E = mc^2$). Antimatter is considered identical to normal matter in

some respects but the exact opposite in others. For example, although the antiproton has the same mass as its counterpart the proton, it is negatively charged instead of positively charged. In our previous papers: “Antimatter's gravity paradox” [1] and "The Photonic Gravitational Paradox" [2], we show two paradoxes that lead us to the definitive conclusion that anti-matter must impose "anti-gravity" and time "anti-dilation" (time runs faster) meaning if matter curves apace-time, antimatter stretches space time while causing it to expand.

Hubble is known for showing that the recessional velocity of a galaxy increases with its distance from the earth, implying the universe is expanding. This recessional velocity was measured by detecting the redshift deviation of the photonic radiation of those stars. As we claimed before, anti-gravity tend to stretch space-time (contrary to gravity that tend to curve space-time). We claim that the expansion of space is caused by the anti-gravity of those antimatter particles. Since anti-particles are spread equally all over the space, each portion of space is stretched equally.

The "accelerating expansion of the universe" is the observation that the universe appears to be expanding at an increasing rate. The accelerated expansion was discovered in 1998, when two independent projects, the Supernova Cosmology Project and the High-Z Supernova Search Team simultaneously obtained results suggesting an acceleration in the expansion of the universe. In June 2016, NASA and ESA scientists reported that the universe was found to be expanding 5% to 9% faster than thought earlier, based on studies using the Hubble Space Telescope [3].

Although the amount of anti-matter particles, that produced and survived since the "big bang", might explain the expansion detected by Hubble, it is not enough to explain the accelerating expansion as mentioned.

In this article we suggest an additional significant source that might supply enough antimatter particles to explain the accelerating expansion of the universe phenomena.

2. The source for the accelerating expansion of universe.

Hawking radiation is black-body radiation that is predicted to be released by black holes, due to quantum effects near the event horizon. It is named after the physicist Stephen Hawking, who provided a theoretical argument for its existence in 1974, and sometimes also after Jacob Bekenstein, who predicted that black holes should have a finite, non-zero temperature and entropy. Hawking's work followed his visit to Moscow in 1973 where the Soviet scientists Yakov Zeldovich and Alexei Starobinsky showed him that, according to the quantum mechanical uncertainty principle, rotating black holes should create and emit particles [4].

Based on Heisenberg’s uncertainty principle it is concluded that the vacuum is filed with matter and anti-matter virtual pairs (“quantum foam”) that pop out and annihilate back in a very short period of time (Fig.1).

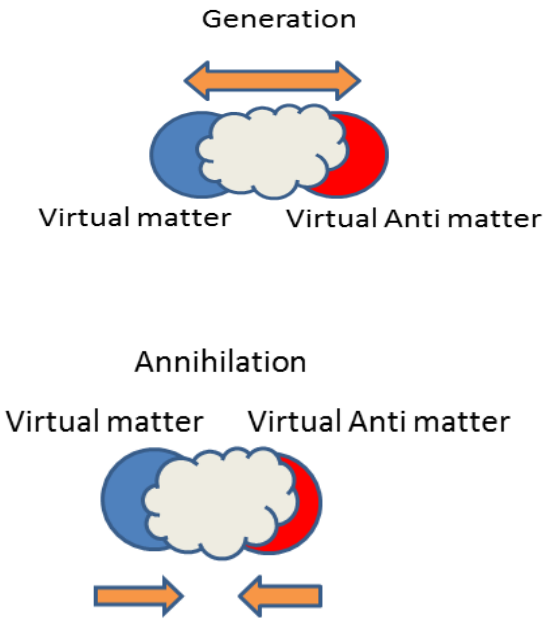

Figure 1. Generation and annihilation of virtual matter and anti-matter pairs out of the vacuum based on Heisenberg's uncertainty principle: $\Delta E * \Delta t \geq \frac{h}{2*\pi}$

When this quantum effects happen just outside the "event horizon" of a black hole, there is a chance that one of these virtual particles will pass through the event horizon and be sucked forever into the black hole while its partner virtual particle remains outside the event horizon free to float in space as a real particle. (Fig. 2).

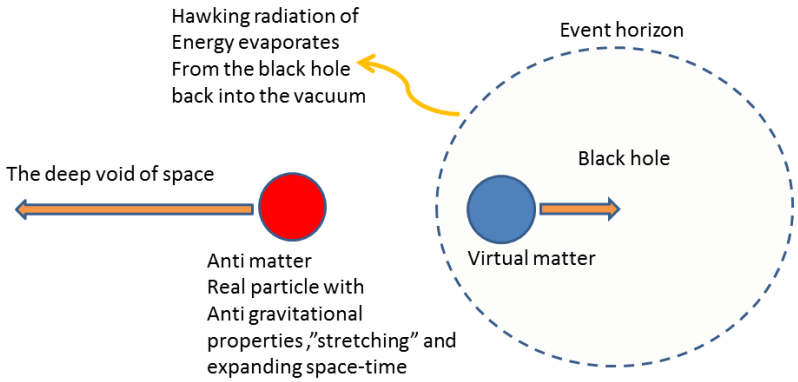

Figure 2. When a virtual particle pairs are generated near the event horizon (from the outside), sometimes, the matter particle will be sucked into the black hole and the antimatter virtual particle will be rejected into deep space (because of its anti-gravitational properties) while becoming a real particle.

Based on that theory we claim that during the hawking radiation procedure, virtual matter particle have much larger probability to be sucked by gravity, passed the "event horizon", into the black hole then its copartner the anti-matter virtual particle. Because of its anti-gravity characteristic we claim that the antimatter particle have larger probability to be rejected away. This newly “born” anti-matter particle is adding to the expansion of space by stretching space in its surrounding. This leads us to the conclusion that hawking radiation is an additional significant source for generation of new anti- matter particles, spread in deep space, causing the expansion of space. As long as the number of black holes will keep growing statistically throughout space, the number of these new antimatter particles will increase, and if this increase (per volume of space) is larger than the increase in the expansion rate of space (per volume of space) there will be acceleration in the expansion of space.

3. Conclusion

The Hawking radiation mechanism generates mostly new real antimatter particles in the void of space. because of the anti-gravitational nature of anti-matter [2], these new antimatter particles contribute to the expansion of space-time and if the rate of this generation of anti-matter new particles (a function of the growth of the black holes throughout the universe) is larger than the rate of the expansion of space time then it will also contribute to the acceleration of the expansion of space-time. These anti-matter particles, created out of vacuum near the event horizon of a black hole and rejected because of their anti-gravitational nature into the void of deep space, might be a partial explanation for the mysterious dark energy.

References

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Figure legends:

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