Where is antimatter?

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Although matter and antimatter have equally produced in the universe, physicists cannot find too much antimatter. We show that the main part of the antimatter exists and have located in the disk of the black holes. A ring of the positrons is covered by a ring of the electrons, while both rings have trapped in a strong electric field. The high-density ring of the positrons makes a wall against the gamma-rays. Blocking the gamma-rays by a wall of the positrons makes a photon ring that would be a good sign for finding the exact location of the antimatter ring. The main part of the supermassive objects in the space have made of antimatter.

Introduction

In 1928 Theory of matter and antimatter has been released by P.A.M. Dirac (1-2). Dirac predicted that each particle has a corresponding antiparticle, with an identical mass and opposite electric charge. The first electron with a positive charge has discovered by Anderson in 1933 which is called the positron (3).

When a particle meets its antiparticle, they annihilate with together. The energy that produces within the annihilation of particles is equivalent to their total mass, which would be converted into a combination of new particles, kinetic energy, and gamma-ray (4). The matter-antimatter annihilation produces more energy per unit mass than any other means of energy production (5). Also, the Superheated electron-positron area, which has been called plasma, had a basic role in the early universe and producing galaxies (6).
Producing matter and antimatter in the space through electric fields has been investigated in the last century (7). Although there are many pieces of evidence of the matter in the universe, scientists don't have any sign of a huge amount of antimatter.
Black holes are a kind of supermassive objects in the universe. There are a few information about creating a black hole and their structure. We know that almost all supermassive objects have a thin disk around the center of the object, while a jet of electrons come out from the center. The Event Horizon Telescope (EHT) Collaboration has published an image of the black hole (8–11).
In this paper, we propose a novel structure of the black hole, including an electric field structure, which could be trapped free electrons and positrons. We show that the major part of antimatter exists and has been in the disk of the black holes and the supermassive objects. Also, we show that changing the direction of the gamma-rays by the antimatter makes a "photon ring" of the black hole (12–16).

Methodology

After producing a positron and electron pair from gamma-ray, we have four rules:

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1. The velocity of the positron is greater than the velocity of the electron:
   $V_p = L\, V_e$ and $L > 1$
2. In a nonelectric field, positron and electron move in the same direction while at the electric field or electromagnetic field, they move in the opposite direction because of their opposite electrical charge.
3. In an electric field or electromagnetic field, if electron and positron move in a circular path like Fig.1. The amount of return backward for the positron is greater than the electron (PD′<PB′) Fig.2 and Fig.3.
4. The higher temperature in plasma causes to decrease the electron-positron average reaction rate. Higher temperature causes delayed annihilation (5).

The first three rules have been collected from real pictures of the Bubble chamber that are like Fig.1.

The longer radius of the positron indicates a higher velocity of the positron (first rule) because the mass of electron and positron are equal, and the electromagnetic field is the same. Here is the formula according to moving particles in an electromagnetic field (17):

$r = mv/qB$ or $v = rqB/m$

$m_e = m_p$

$q_e = q_p$

$r_p > r_e$

hence

$v_p > v_e$

B is the electromagnetic field, q is the electrical charge, m is the mass, r is the radius, and v is the velocity of the particle.

According to the rule number 2 in a nonelectric field, we expect that electron and positron move in a straight direction. The velocity of the positron is greater than the velocity of the electron, hence the distance between positron and electron would be increased along the time (second rule). Moving in the opposite direction in the electromagnetic field implies the opposite charge of electron and positron.

We expect that the amounts of return backward of both particles are deference. In Fig.1, although AB is close to zero, the CD is greater than zero. In the circular movement, regardless of the real length of the lines AB and CD, we use this rule: PD′ < PB′. D′ is the image of the D, and B′ is the image of the B on the gamma-ray direction line. Also, P is a point on the gamma-ray direction line that was chosen as a source of comparing the amount of return backward (OP > r). In Fig.1, the amount of return backward of Positron is equal to the length of the line OD′, while the return distance of the electron is equal to the length of the line OB′. This rule has been obtained from the popular real pictures in the Bubble Chamber (third rule).

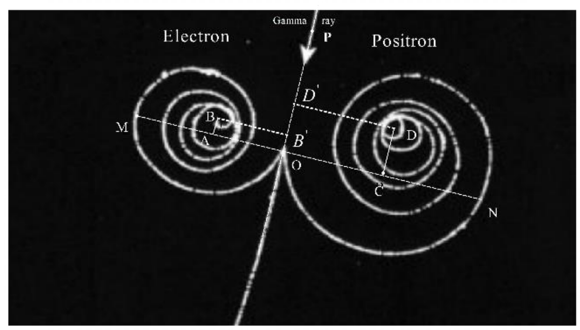

Fig.1. **The greater radius and velocity of the positron.** Producing electron and positron from gamma-ray and moving in the opposite direction in the supper heated electromagnetic field. The greater radius of the positron shows its higher velocity (PD’ < PB’) (17).

If we have a gamma-ray with more energy, more speed of particles make new paths. In this case, the radius of circles would have increased, and centers of the circles would be located below the line MN Fig.2. More increasing of gamma-ray energy makes particles with higher velocity and their path would be close to the straight line. This rule is not valid for noncircular movement.

Fig.3(a) shows the location of the centers (B, D) of the circles and their images on the gamma-ray direction line (B′, D′) above the line MN, while Fig.3(b) illustrate the location of the centers (B and D) of the circles and their images on the gamma-ray direction line (B′, D′) below the line MN. In the both figures (Fig.3(a) and Fig.3(b)) PD′ < PB′ (Third rule).

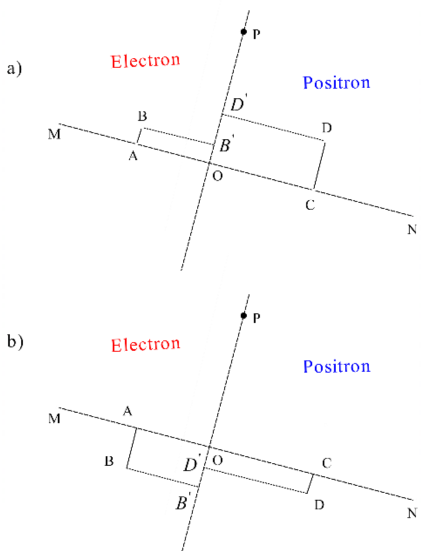

Fig.2. **Comparing Return distances.** In the circular movement, the return backward distance of the positron is greater than the return backward distance of the electron PD′ < PB′.

If we have more than one gamma-ray direction and all rays have been received from point P, in a 2-dimensional view, we would have expected to see all positrons on a circle that is covered by a circle of all electrons Fig.3(c).

At the beginning of the producing electrons and positrons, the ratio of the reaction between them is high. This reaction is exothermic, therefore causes to increase the temperature of the area. Higher temperature causes to decrease the possibility of the new reaction. Finally, according to the fourth rule, we expect that a superheated area causes to decrease the ratio of the reaction between electrons and positrons.

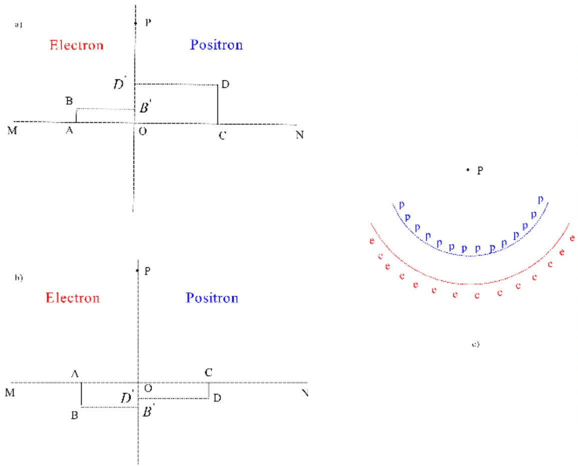

Fig.3. **Rings of the electrons and positrons.** Distances in the (a) and (b) show that the distance of the positrons from the center of the gamma-ray source is less than the distance of the electrons from the gamma-ray source. (c) Particles make two separate rings around the source.

Electron–positron plasma and annihilation

Annihilation means collision between a particle and its antiparticle to produce other particles or photons. The simplest annihilation is a collision between low energy electron and positron to produce two photons (18-22).

We investigate annihilation between particles that have been continuously produced by gamma-rays' bursts in different times and energies. We categories them into three separate models based on their producing time and frequency of gamma-rays. These models are important because we expect that after annihilation between particles, we lose some particles while remain particles shape a new super-heated electric field which is called electron-positron plasma. Electron–positron plasma plays a fundamental role in the creating of ultra-massive astrophysical objects and associated with the emission of ultra-bright gamma-ray bursts in the space (23-26).

Possibility of creating an electric field

According to the different energy of the gamma-rays and their emission time, we investigate the chance of creating an electric field in a plasma in three different models. The energy of gamma-rays are high and make space hot. In the first model, we assume that two gamma-rays with different frequencies have emitted at the same time and produce their particles at the same time. In the second model, we investigate two gamma-rays with different energies, while lower frequency gamma-ray have emitted before higher frequency gamma-ray. Finally, in the third model, we assume that gamma-ray with higher energy has emitted before gamma-ray with lower energy.

At the beginning of the producing particles, we have a mixed area of electrons and positrons that have a chance to annihilate with each other. In the nonelectric field, electrons and positrons that have been produced in one direction, move in a straight direction and annihilation occurs between particles with opposite charge and different velocity. Although differences between the times of producing electron-positron pairs could be too low, because of the high velocity of particles, the distance of them might be too much for annihilation.

Three models of creating the electric field

Fig.4 illustrates the sequence and velocity of particles in the first model. In the first model, we assume that two gamma-rays with different energies have produced their electron-positron pairs at the same time. Frequency of gamma-ray 1 is lower than the frequency of gamma-ray 2 Fig.4(a), hence the lengths of the velocity vectors of its particles are less than the length of the velocity vector of gamma-ray 2 particles, respectively Fig.4(b).

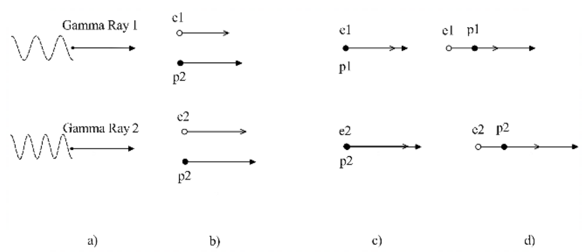

Fig.4. **Different velocity of the electron and positron.** In the first model, particles of both rays have produced simultaneously, while moving with different velocity. (a) Shows the different frequencies of the gamma rays. (b) Introduces electron and positron with their velocity, respectively. (c) Illustrates the start point of the pairs and (d) shows the increasing distance between electron and positron in a nonelectric field.

Due to the higher frequency of gamma-ray 2, we would expect that:

$V_{p2} > V_{p1}$

$V_{e2} > \ V_{e1}$

hence

$V_{p2} > V_{e1}$

while there is no direct relation between $V_{e2}\ and\ V_{p1}$.

Also

$(V_{p2} - V_{e1}) > (|V_{p1} - V_{e2}|)$

In this case, after producing particles, we could sure that:

If $V_{e2} \geq \ V_{p1},\ e_2$ would have a collision with p_1.

Annihilating between e_2 and p_1 increases the temperature of the area. Particles p_2 and

e_1 move in a straight line, while their distance increase Fig.5. Also increasing the temperature of the annihilation zone, decrease the rate of $p_2 - e_1$ reaction but no electric field creates.

If $V_{e_2} < V_{p_1}$, there would no annihilation between them. Matter and antimatter continue their expansion. In this case, there is no chance of creating a superheated zone.

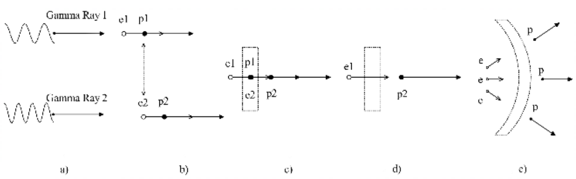

Fig.5. **Annihilation between particles.** (a) Two gamma-rays with different frequencies. (b) When the velocity of the e_2 is greater than the velocity of the p_1, e_2 would collide with p_1. (c) Annihilation time. (d) After annihilation e_2 and p_1 change to gamma-ray. (e) For all directions of rays, all p_1 and e_2 annihilated and we have a superheated area.

Fig.5 shows that the probability of producing an electric field between particles in a straight movement is too low. However, investigating the relation between particles with their neighbor particles on the other radius of the circle is important. In fact, we should investigate the possibility of creating an electric force between neighbor particles. This electric force would be covered all surface of the emission and reduce the speed of particles or even stop them.

Fig.6 illustrates that neighbor particles are the particles that are on the two close radiuses of the burst circle. We assume that the angle between these radiuses is too low and we can assume them as parallel lines. Probability of the creating electric field between these neighbor particles, increase after annihilation between the first group of particles and decreasing the ratio of reaction between them (rule 4).

In the model 2 and model 3, like model 1, middle particles annihilate with together, and superheated area creates but strong electric force between the remain particles on a straight line doesn't exist.

The electric field between the neighbor particles

At this stage, we investigate the possibility of producing a strong electric field that may be created between neighbor particles.

In model 1, both particle pairs have created at the same time. If $v_{e_2} > v_{p_1}$ (Fig.6(a)), e_2 and p_1 meet each other with a suitable distance. Because of the superheated area, their chance to annihilate is low, and they could attract each other.

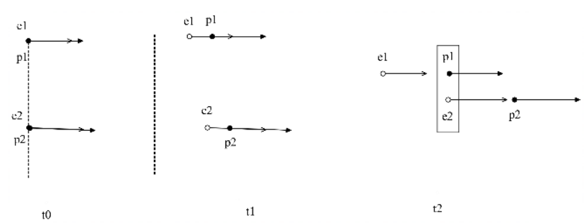

Fig.6. **Dipole of neighbors**. Producing single dipole of electric charges between neighbor particles without annihilation in the superheated area.

If we imagine an explosion that all rays emit in a circular shape, while e_2 and p_1 meet each other, all particles around the circle would have the same situation. In this situation, all e_2 particles and all p_1 particles attract each other. We would have a circle of opposite particles that each particle is between two particles Fig.7.

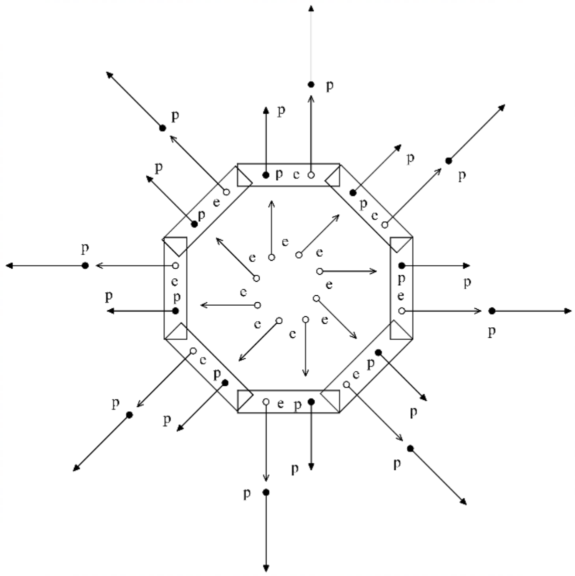

Fig.7. **First electric field layer.** A simple ring of dipoles makes the first layer of the electric field.

The charge of the middle particle is the opposite of the other particles. This sequence of opposite particles make a strong electric field and prevent new particles to continue their movement. (Fig.8(a))

New particles shape a new circle of opposite particles and make electric field stronger Fig.8(b).

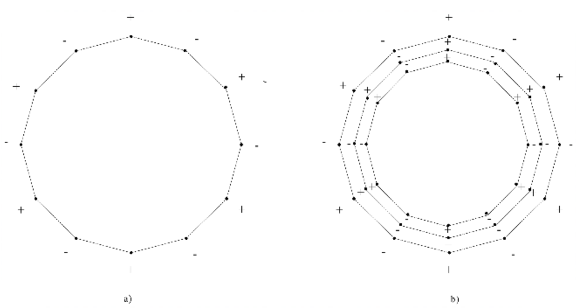

Fig.8. **Electric field.** (a) One-layer electric field. (b) Multi-layer electric field.

Although in the model 2 and model 3 there are more initial statuses and more options to create the electric field, the total results are the same. Fig.9 shows the two possibilities of creating an electric field. Also, Fig.10 illustrates the one type of meeting neighbor particles in model 3 and establishing the electric field.

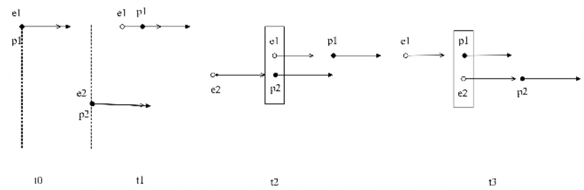

Fig.9. **Possibility of producing dipoles in type 2**. (a) Producing pair 1. (b) Producing pair 2 after a delay. (c) Dipole between p_2 and e_1. (d) Dipole between e_2 and p_1.

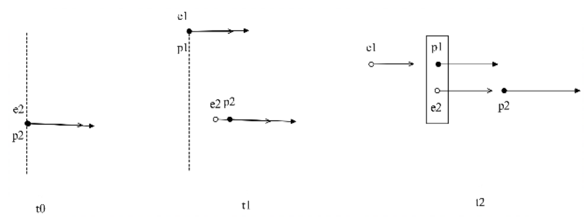

Fig.10. **Producing dipoles in type 3**. (a) Producing pair 2. (b) Producing pair 1 after a delay. (c) Dipole between e_2 and p_1.

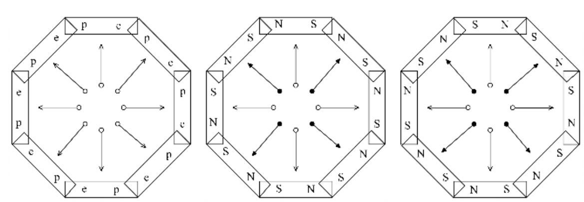

Fig.11. The similarity between the electric field and electromagnetic field.

Effect of electric field on the particles

At this stage, after creating a strong electric field, all new particles should move within a strong electric field. Because of the opposite charge, the forces on the electrons and positrons are in the opposite direction, hence they change their direction in the opposite direction like Fig.12.

Electric field forces particles to change their path and rest in an area (rest particles) or even move on a circular path around the source of the rays. Fig.12(a) shows two sample paths of the electron movement. Electrons move in a circular path and rest on a red circle area. Although we call these particles as the rest particles, we know that there is a high possibility of rotating these electrons around the center of the electric field. Also, Fig.12(b) illustrates two sample paths of positrons within the electric field. Different energy of gamma-rays makes particles at different speeds. In this situation, we just sure that the density of positrons in the inner area is more than the density of the electrons because the different velocity of particles makes different return distances.

Although a group of gamma-rays with the equal energy would have located particles on two different circular, different energy of gamma-rays would have made irregular shape.

New particles that come from the center toward the out of the circles, don't annihilate with other particles, because of the superheated area. On the other hand, the collision between new particles and rest particles is possible. the kinetic energy of new particles causes the new movement of the rest particles toward the out. New movement direction changes to circular path movement and returns more back toward the center Fig.12.

$$m_1 v_1 + m_2 v_2 = m_1 v + m_2 v$$

$$v_1 = 0$$

$$m_1 = m_2$$

Hence

$$v = \frac{v_2}{2}$$

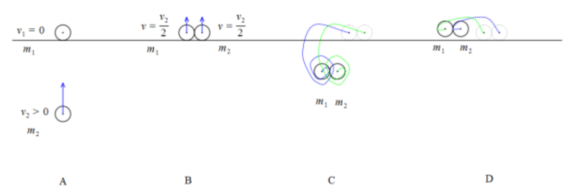

Fig.12. **Return backward in the superheated strong electric field**. Possibility of situation c is greater than possibility of situation d. (a) m_2 with velocity v_2 comes from the center toward m_1. (b) At the collision time we expect that both particles move with half of v_2 while m_1=m_2. (c) Electric field causes they move in a circular path and return. (d) final location of particles when speed is high.

The density of the positrons in the inner area is more than the density of the electrons, hence the probability of the collision between new particles and positrons is higher than the probability of collision between new particles and electrons.

Return distance of outer electrons is more than return distance of inner electrons, because inner electrons are closer to each other and repulsive force between them is more. Also, repulsive force between positrons cases outer positrons return more back toward the center than inner positrons.

The collision between new particles and the rest particles, move them toward the center. Also, the return distance of the outer particles is more than the return distance of the inner electrons. These two movements shape two different circular area. The outer circle is made of electrons, and the inner circle is made of positrons. Both circles have located in the electric field Fig.13(b).

In a 3-dimensional view, surfaces of rings are between surfaces of the electric field. The electric field has more height and has produced form multi electric field surfaces. In the simplest view, we can imagine two parallel electric fields that each one has its own layers, while new rings of electron and positrons have trapped between them.

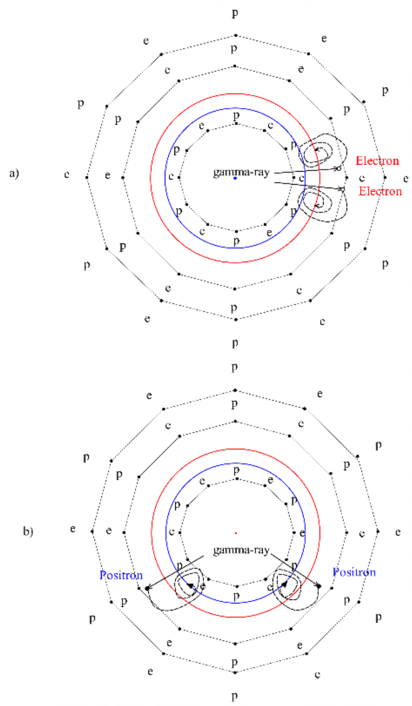

Fig.13. **Opposite direction of movement in the electric field.** (a) Circular path of electrons. (b) Circular path of positrons.

Antimatter and flow of the energy

Fig.14 shows that a major part of the positrons locate on the inner circle, while the major part of electrons has located on the outer circle. Positrons have covered by electrons.

Electrons on the red circle cannot move toward the positrons on the blue circle because of the repulsive force between electrons. Also, the strong electric field around the red circle would have prevented electrons to exit of the electric field and return them to their position. In this situation, electrons move circularly around the center of the circle and make a new strong electromagnetic field.

On the other hand, any attempt of positrons on the blue circle for moving toward red circle causes to return them to their position or even more movement toward the center of the circle. Therefore, electrons and positrons on the circles don’t have much chance to attract each other and annihilate with together.

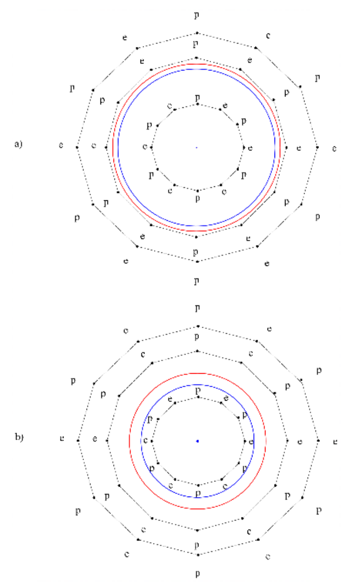

Fig.14. **Circles of electrons (Red color) and positrons (blue color).** (a) Locating electrons and positrons near each other at the beginning. (b) Moving particles toward the center after hitting by new particles.

Increasing the density of positrons makes a wall of positrons against the gamma-rays that come from the center. This wall can reduce the flow of energy, change its direction or even block it.

Sphere or thin surface ring?

According to the source of the gamma-rays, we could expect that we have two different shapes of the electric field and location of the positrons and electrons.

If we imagine a point at the center that is shining during the time and sending gamma rays toward the all direction, we have a sphere area. In this case, the electric field would be created in a sphere shape and we would have two spheres of electrons and positrons.

If the source of gamma-rays sends rays in one (or two opposite direction). The source should rotate continuously and send rays during the time. In this case, we have a thin surface of the electric field and two thin rings of electrons and positrons.

Where is antimatter?

Now, we sure that the main part of antimatter in the universe has located in the center of black holes and supermassive objects in the space. The basic part of the heavy mass of blackholes belongs to the antimatter. The density of antimatter is too high, while it is increasing in the active supermassive objects. Quasars are good examples of the supermassive objects.

Blocking the gamma-rays by a wall of positrons makes a high-bright edge and would be a good sign to find the exact location of the inner side of the antimatter ring. Also, if we assume that existing jet in the black holes and the supper massive objects is a good sign of active objects, we would sure that these objects have an active superheated disk. This disk covers both rings, and the movement of electrons within the disk around the center of the disk creates a strong electromagnetic field around the black hole.

We are sure that the amount of matter and antimatter that have produced in the universe are equal.

We suggest that a high-density electron ring that has located in a superheated strong electric field is a good tool for keeping a tremendous amount of antimatter.

The number of positrons, electrons, and their density would be increased, along the time, while these circles don’t have infinite capacity. The negative charge of the electrons causes them to repel each other, while positrons have a positive charge and repel each other.

Conclusion

In an enormous gamma-ray burst, after producing electron-positron pairs, we lose some particles because of the annihilation, while remain particles could shape a new super-heated electric field, which is called electric plasma. According to pictures that have been taken in bubble chambers, the amount of return distance of the positron is greater than the amount of the electron's return backward. In the electric plasma, the probability of moving particles toward the center of the outburst is more than the probability of moving away from the center. Also, in the electric plasma, the average return distance of particles in outer layers are more than average return distance in inner layers. The major part of the antimatter has located in the black holes and supermassive objects in the space. In the disk of the black hole, the major part of the positrons has located in the inner circular area, while the major part of the electrons has located in the outer circular ring. The ring of the positrons has covered by the ring of the electrons, while both rings have trapped in the electric field. The positrons make a wall against the gamma-ray burst and could change the direction of the rays. Blocking the gamma-rays or changing their direction makes a high-bright edge and would be a good sign to find the density of the positrons, age of the black hole and exact location of the inner side of the antimatter ring.

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