Cherenkov radiation of gravitational waves

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Abstract: If the velocity of gravitational waves is less than the speed of light, the velocity of mass motion may exceed the velocity of gravitational waves. This will cause Cherenkov-like radiation similar to electromagnetic interaction. The Cherenkov-like radiation of gravitational waves will produce a relatively specific observable effect. Due to the concentrated release of energy, the easiest to observe is that a large number of photons are radiated from the Cherenkov-like radiation source to form optical effects of high intensity and relatively special shapes. The speed of gravitational waves is less than the speed of light, because the compression of space and time by very large masses causes the gravitational waves to travel less in the masses than the speed of light. The mass of the material itself is not affected by this space-time compression. Thus, under certain conditions, the velocity of the mass of matter exceeds the velocity of the gravitational wave, forming a Cherenkov-like effect. A typical example is the aura of special structures formed by the supernova explosion. Among them, the supernova 1987A has been in existence for more than 30 years. After several years of the explosion, through the observation of the high-resolution Hubble telescope, it was found that the supernova 1987A showed two distinct auras in its explosion direction. There are many explanations for how these halos are formed. This paper points out that the formation of the two halos of the supernova 1987A is related to the propagation of gravitational waves in the mass of matter. Due to the very high mass density of the supernova explosion area, the space-time compression effect is very obvious, which will cause the gravitational wave to have a wave speed less than the speed of light. The material ejected by the supernova after exploding is close to the speed of light, and it is easy to exceed the velocity of gravitational waves propagating in the cosmic fluid around the supernova explosion, which will form the shock wave effect of gravitational waves. The Cherenkov effect of gravitational waves can also be used to explain the origin of high-intensity photon radiation in some galaxy centers. When the black hole in the center of the galaxy attracts the outer mass, the closer it is to the central black hole, the faster it moves. In the right position, the mass moves faster than the gravitational wave. The Cherenkov-like radiation of gravitational waves will be product. In addition, if there is a white hole, the energy is continuously released from the source of the white hole, which will also cause the mass ejection speed to exceed the speed of the gravitational wave, and thus produces the Cherenkov-like effect. Since the dynamic mechanism of the black hole and the white hole are different, by observing the Cherenkov-like effect of the center of the galaxy, it can effectively distinguish whether the center of the galaxy is a white hole or a black hole.

Key words: gravitational wave; supernova 1987A; black hole; white hole; shock effect

1 gravitational wave speed

1.1 Gravitational wave solution

From the perspective of Einstein's gravitational wave, it is a very large approximation. This also means that the plane wave solution of Einstein gravitational waves needs to meet the requirements of weak field approximation. In the case of a weak field approximation, the mass is not large enough. Therefore, the phenomenon of space-time compression is not obvious, and the propagation speed of natural gravitational waves is basically consistent with the speed of light. In this case, there is generally no case where the mass velocity of the material exceeds the gravitational wave velocity.

In the case of a strong gravitational field, the plane wave solution cannot be accurately obtained. But I believe that gravitational waves still exist. It is only possible that there are more complex nonlinear relationships. These nonlinear relationships may bring about some important characteristics of gravitational waves, which need further exploration of the theory.

1.2 Gravitational wave velocity

However, for the calculation of the velocity of gravitational waves, in Einstein's gravitational wave theory, the speed of gravitational waves defaults to the speed of light. Such a conversion relationship between space and time is ct. This includes the speed of light c. Therefore, the wave velocity of the gravitational wave is a parameter directly related to the spacetime structure in which the gravitational wave is located.

Therefore, whether it is a strong gravitational field or a weak field approximation, in the frame of reference generated by gravitational waves, the velocity is always maintained at the same speed as c. However, considering that in the presence of very large mass and space time will be severely compressed, which will result in slower time. Therefore, although the velocity of the gravitational wave is still the speed of light c in the reference frame of the position where the mass is located, the velocity is calculated by the effect of the slower time in the strong gravitational field $v=s/t$. where s is the distance that gravitational wave traveled, and t is the time it takes for the gravitational wave to cross this distance.

Such a slowing of time t directly leads to a decrease in the velocity v of the gravitational wave as seen in the vacuum reference frame. Therefore, in the vacuum reference system, the wave speed of the gravitational wave will be lower than the speed of light.

On the other hand, for the mass itself, from the vacuum reference system, if there is no other mass around the mass, so the compression of its surrounding space and time is generated by itself, and there is no external mass to compress the space and time. Therefore, the speed of mass motion can only be measured from the vacuum reference frame directly, so it can approach the limit of the speed of light in vacuum.

This will cause the mass running speed to exceed the gravitational wave speed. The mass running speed exceeds the gravitational wave speed, which will inevitably produce a shock wave effect just like the Cherenkov radiation

2 Cherenkov radiation

Mechanical shock and electromagnetic waves are generated by the shock wave effect. In the case of mechanical vibration, when the motion of the object exceeds the propagation speed of the mechanical wave, a very significant shock wave effect occurs. For example, the speed of the ship exceeds the speed of water wave propagation, and the speed of the aircraft exceeds the speed of sound.

Figure 1 shows the air shockwave generated by a supersonic aircraft breaking through the sound barrier (Source: https://hearinghealthmatters.org/hearinginternational/files/2015/05/sb2-1024x349.jpg).

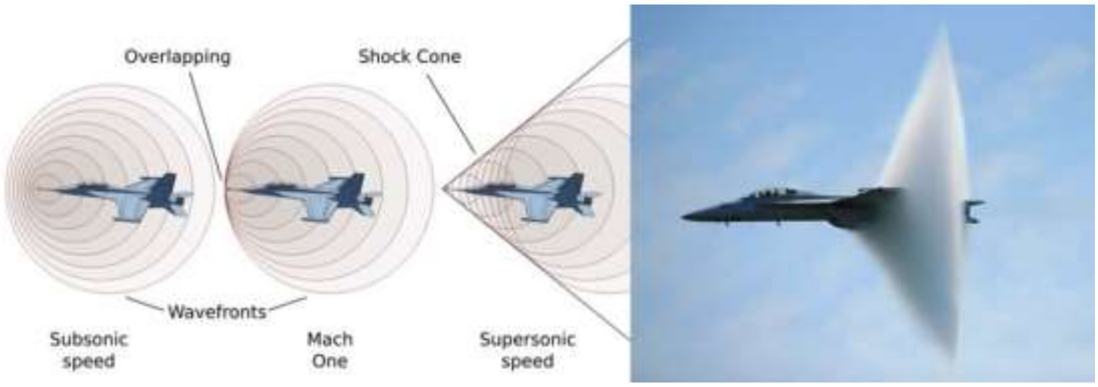

Figure 1 Effect of supersonic aircraft breaking through the sound barrier and causing air vapor condensation

If it is an electromagnetic wave, when the speed of the object moves faster than the speed of light, the shock wave effect of the electromagnetic wave occurs, such as Cherenkov radiation. Since the speed of light in the water is much lower than the speed of light in the vacuum, when the velocity of the particles exceeds the speed of light in the water, a shock wave effect occurs in the water. This effect is called Cherenkov radiation. Figure 2 is the aura of the Cherenkov radiation generated by the high-speed movement of neutrino in the water detected by a super-Kamioka detector. Figure 3 is a graph of the large amount of Cherenkov radiation blue light produced during the nuclear reaction.

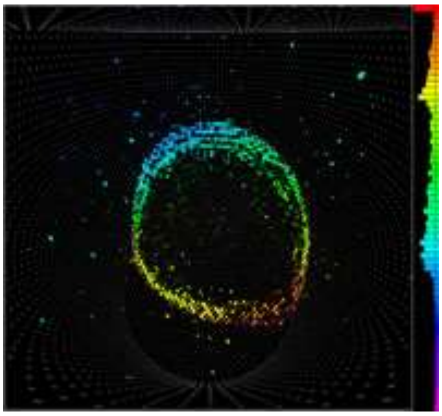

Figure 2 The Cherenkov Aura formed in the Super Kamioka Detector (Source: http://www-sk.icrr.u-tokyo.ac.jp/sk/detector/cherenkov-e.html)

Figure 3 Blue light due to Cherenkov radiation in a nuclear reactor (Source: https://commons.wikimedia.org/wiki/File:TrigaReactorCore.jpeg)

Since the velocity of the gravitational wave is the speed of light, if the velocity of mass motion exceeds the velocity of gravitational wave, it is more similar to the effect produced by Cherenkov radiation. This means that we can observe photon radiation that produced by the high density mass movement. It is similar to the Cherenkov radiation effect in nuclear reactor.

3 Supernova 1987A

After the explosion of the supernova 1987A, three or four halos appeared, and the four halos showed very good symmetry in both directions. The two small halos that overlap inside are relatively close to the position of the supernova, and the two large halo of light are far away from the eruption position. This is the result of a large amount of mass exceeding the gravitational wave velocity instantaneously. Since the gravitational wave cannot propagate to the front of the high-speed motion mass, a large number of gravitational waves are superimposed behind the mass to form a conical structure. There are usually two shock waves formed by a supersonic aircraft, so there are two shock waves formed by gravitational waves, namely the front shock wave and the back shock wave. For supernova explosions, the projection of matter is symmetrical, so two opposite directions form two shock waves. The total number of shock waves formed by this supernova explosion is four. That is, the pattern shown in Figure 4.

Figure 4 Aura formed after the outbreak of supernova 1987A (Source: https://www.spacetelescope.org/images/opo9719b/)

As for the light emitted by the aura, it is formed by the concentrated release of energy at certain spatial points.

4 High-brightness light in the center of some galaxies

Light is usually very strong in the center of many galaxies. Figure 5 shows the high-intensity light from the center of the spiral galaxy M100.

Figure 5 High-brightness light from the center of the spiral galaxy M100 (Source: https://hubblesite.org/image/4280/gallery)

If it is because the stars in the center of the galaxy are dense, it will emit strong light. This means that the galaxy center has a very large mass. However, from the general theory of relativity, it can be found that if so many stars are gathered, it means that black holes will form in the center of the galaxy. The formation of black holes will in turn reduce the brightness of the black hole in the center of the galaxy. Therefore, the brightness of the center of the galaxy should not be so large. This should be possible for computational analysis. I am not going to do such calculations here. Of course, if you feel it is necessary, I can also conduct a detailed analysis in the next article.

Figure 6 shows the photo of a black hole. It can be seen that the brightness of the black hole is not high.

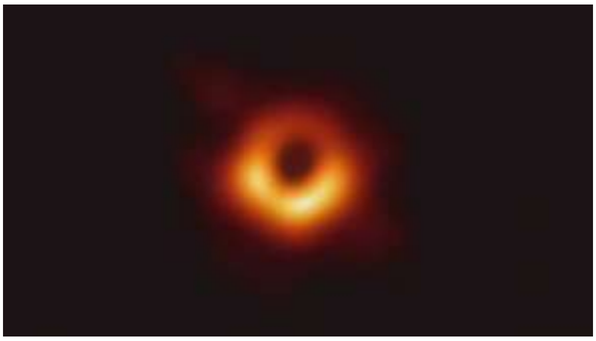

Figure 6 The photo of a black hole (Source: https://www.jpl.nasa.gov/news/news.php?feature=7372)

However, if we see this problem from the perspective of the Cherenkov-like radiation of gravitational waves, the relevant questions can be effectively solved.

First of all, galaxy centers such as the Milky Way do have a large mass collection, and the mass is large enough to form huge black holes. Judging from the recent photograph of the black hole, the black hole itself does not emit a uniform and intense light. Therefore, although the black hole in the center of the galaxy itself produces Hawking radiation, the emitted light is uneven in brightness and the brightness is not high.

But the formation of black holes means that a large amount of matter will be attracted. If the mass attracted by the black hole exceeds the speed of gravitational wave propagation, it will form a kind of Cherenkov-like radiation of gravitational waves and produce high-brightness photons that generated by large mass collection. This is the same principle as the Cherenkov radiation in a nuclear reactor emitting a uniform blue light.

Then there will be a problem here: if the black hole absorbs the mass, it will produce Cherenkov-like radiation. If it is the opposite "white hole" and continuously throws the masses outward, the projected masses move faster than the gravitational wave. It will also produce high photon radiation. Therefore, if such gravitational wave Cherenkov-like radiation exists, it means that the light in the center of the high-brightness galaxy may be emitted by a black hole or by a white hole. As for the difference between the two types of Cherenkov-like radiation light, further research is needed. If we can make a clear distinction, this will help us to understand more deeply how the galaxy works and the origin of the universe. Table 1 shows some comparisons between white and black holes.

Table 1. Some comparisons between white and black holes

Types of	Black hole	White hole
Effect	Absorption mass	Release mass
Single evidence	Black hole photo	Supernova explosion
Most likely location	Galaxy center	Galaxy center
Fluid universe characteristics	Energy into mass	Mass to energy

From the point of view of the effect, the characteristics of the black hole and the white hole are exactly opposite. From the perspective of the fluid universe model, if the universe is in a dynamic equilibrium of energy and mass conversion, the black hole plays a role in continuously transforming energy into mass. The white hole plays a role in continuously converting mass into energy.

The best evidence of the current black hole is a photo of a black hole. White holes can be explained by supernova explosions.

The most suitable location for both structures is usually the center of the galaxy. This is usually a common feature of those spiral galaxies. If there are no black holes or white holes in the center of the galaxy, these galaxies will exist in the universe in the form of a relatively uniform nebula.