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Cherenkov Radiation and Hawking Radiation

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Abstract

While the speed of light has the constant value of 3×10^8 m/s in vacuum, its value diminishes in denser mediums. It is the purpose of this paper to show that as light enters regions of larger gravitational fields such as Neutron Stars and Black Holes light speed is also diminished. We consider the cases of Pulsars, Quasars, and Active Galactic Nuclei, to provide experimental proof that charged particles moving faster than the diminished speed of light in these high gravity regions would radiate energy due to Cherenkov Radiation that has been detected on earth as Radio Waves and X-Rays. We show that there is no experimental evidence for Hawking Radiation since the premise of its theoretical calculation is faulty.

Keywords

Cherenkov Radiation, Hawking Radiation, Gravity, Density, Reduced Speed of Light, Pulsars, Black Holes

1. Gravity, Acceleration, and the Speed of Light

$g = GM/R^2$ can also be written as $g = 4\pi G\rho R/3$ where g is the gravity on the surface of a sphere of density ρ and radius R. Plugging in the value for G we get $g = 2.79 \times 10^{-10}\ \rho R$, noting that for constant R both g and ρ increase in value simultaneously implying that regions of higher gravity are also regions of greater density.

Table 1. Of density experimental results.

SUBSTANCE	ρ in kg/m^3	g in m/s^2	Light Speed c in m/s
AIR	1.225	3.42×10^{-10} R	$3 \times 10^8 = c$
WATER	1,000	2.79×10^{-7} R	$2.25 \times 10^8 = 0.75c$
GLASS	2,500	6.98×10^{-7} R	$2 \times 10^8 = 0.67c$
DIAMOND	3,500	9.77×10^{-7} R	$1.25 \times 10^8 = 0.42c$

Comparing the results of Table 1, we note that as Density increases, Gravity increases, and the Speed of Light decreases.

Since gravity is the same as acceleration as per Einstein's thought experiment (Carroll & Ostlie, 2017: figure 17.6, 615) and noting that both gravity and acceleration have the same units, any accelerating objects such as electrons or protons in a Linear Accelerator or a Synchrotron will also diminish the speed of light. According to Einstein's General Theory of Relativity high gravitational fields compress space (dx becomes smaller) and slow down time (dt becomes larger). Hence the speed of light, c = dx/dt becomes smaller.

2. Cherenkov Radiation

Cherenkov Radiation was first observed by the Russian Scientist Vavilov-Cherenkov as blue light (radiation in the ultraviolet region seen as blue light) emitted by electrons moving faster than the speed of light in water surrounding the rods of the Nuclear Reactor (Figure 1).

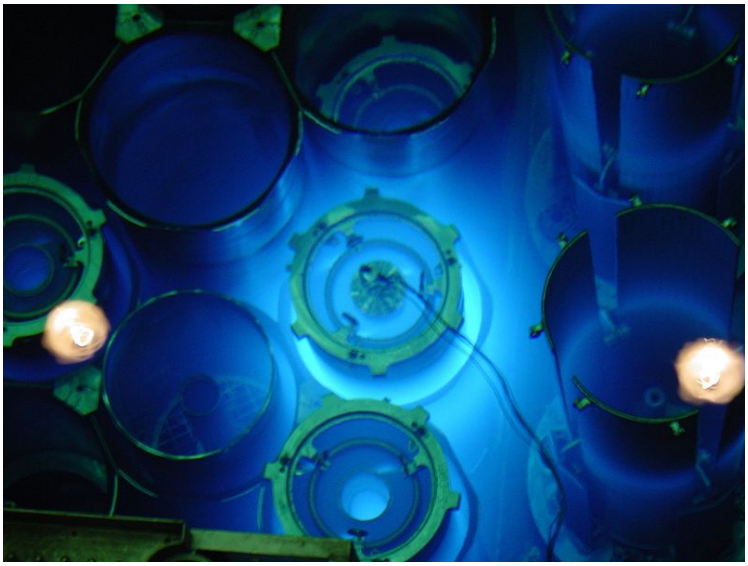


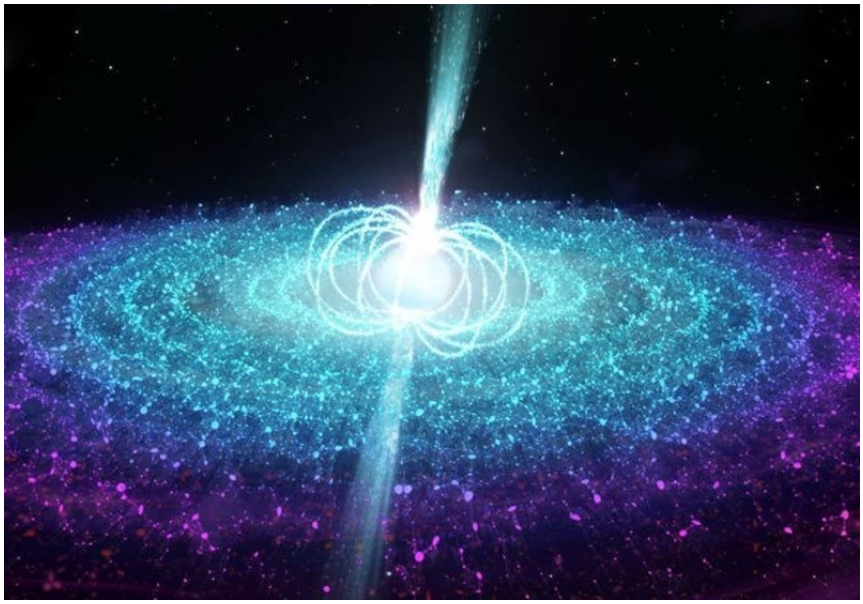
Figure 1. Cherenkov radiation. (This photo by unknown author is licensed under CC BY-NC-ND)

Calculations show that a Neutron Star with a Mass equal to 1.4 × (Mass of the Sun) and a radius of 10 km will have $g = 1.86 \times 10^{12}$ m/s^2, 190 billion times the value of g at the surface of earth (Carroll & Ostlie, 2017: 579).

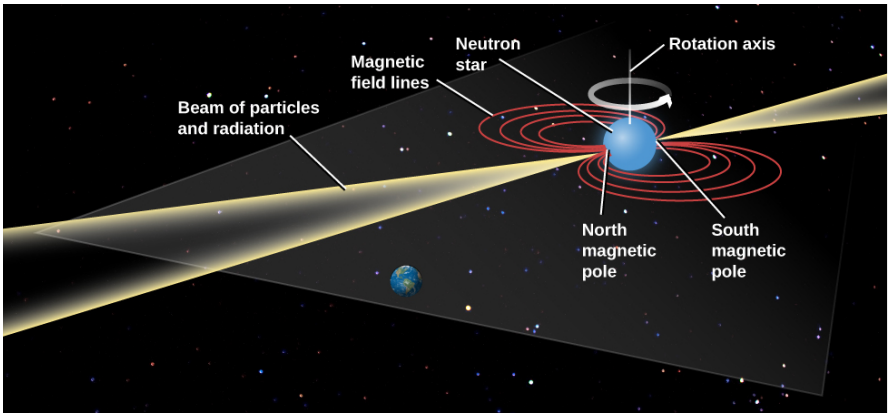
As a gas' temperature is raised to over 10,000˚, its molecules collide so violently that they are broken apart into individual atoms. The negatively charged electrons are knocked completely off the atoms. It is at this point that the plasma state is reached made of electrons and positive ions. Accretion disks have a temperature of several hundred thousand degrees and hence accretion disks are made of a dense plasma of electrons and ions. Since regions of high gravity are also regions of high density, this explains the accretion disks made of highly dense plasma surrounding regions of high gravity fields.

Pulsars are rotating neutron stars observed to have pulses of radiation at very regular short intervals. Pulsars have very strong magnetic fields which funnel jets of charged particles towards the Pulsar at a speed greater than the reduced speed of light. As matter is sucked near a Pulsar it gets ionized and the electrons and ions travel in the direction of the B field. Since the electrons are lighter, they will radiate most of the higher frequency energy due to Cherenkov Radiation. These accelerated particles produce very powerful beams of light ranging from Radio Waves to X Rays depending on whether electrons or ions radiate out their energy, and because of the expansion of space increasing the wavelength or decreasing the frequency of the waves radiated depending on the distance of the Pulsar's location from earth (**Figure 2**).

AGN's were formed by Pulsars that were rotating at a very fast rate for both the mass and the charge of the Neutron Star to have enough energy to form a rotating Black Hole (Irani, 2022). These rotating Black Holes would form a rotating



(a)



(b)

Figure 2. Pulsars. (The photos by unknown authors are licensed under CC BY)

accretion disk around it, rotating with a speed greater than the diminished speed of light which would emit X-rays. AGN's of which Quasars are a part, were formed during the early epoch of the formation of our 3D Universe due to the abundance of Baryonic Matter at that time. Since the ratio of Dark Matter to Baryonic Matter is currently estimated to be about 5 or 5.25 to 1, this implies that our 3-D Universe has advanced toward about 84% completion of the fourth dimension with only 16% of Baryonic 3-D matter currently remaining. AGN's are primordial Black Holes located very distant from the current location of earth because of the accelerated expansion of the Universe, and hence all their higher frequency radiation emitted due to the Cherenkov Effect arrives at earth as Radio Waves (**Figure 3**).

Figure 3. Active galactic nuclei (AGN) as primordial black holes. (This photo by unknown author is licensed under CC BY)

3. Hawking Radiation

All the initial conditions for Hawking Radiation are incorrect:

1) Positive and negative energy "virtual" particles are born because energy must be conserved. This condition is incorrect because electrons and positrons both having positive energy are virtual particles that get their energy from vacuum energy density and return it to the vacuum in the form of two photons.

2) In high gravitational fields "virtual" positive and negative energy particles are turned into "real" positive and negative energy particles. This condition is incorrect because there is no theoretical or experimental proof that high gravity fields can turn virtual particles into real particles.

3) If created near the event horizon of a Black Hole the negative energy particles fall into the Black Hole while the positive energy particle escapes from the vicinity of the Black Hole causing it to lose mass and evaporate, and this effect is called Hawking Radiation as stated by Steven Hawking. This assumption is incorrect as stated. Why would negative energy particles enter the Black Hole while allowing positive energy particles to escape from the vicinity of the Black Hole? We know from the example of accretion disks around Black Holes that it is matter which has positive energy that enters the Black Hole. Neutron Stars also have high gravitational fields and if high gravity fields were to create positive and negative energy particles then where are the negative energy particles?

We show that this scenario of Black Holes losing mass and evaporating is not possible even with electron-positron pairs. The scenario as stated above is of one of the electron-positron pair falling into the Black Hole while the other escaping from it is not possible. The Attractive Force between an electron-positron pair in close proximity to each other is given by $F = ke^2/r^2$ where $r = 9.36 \times 10^{-16}$ m is the distance between the centers of the pair which equals 263 Newtons since electrons and positrons each have a radius of 4.68×10^{-16} m (Irani, 2024). The pair are attracting each other and are being pulled inward together by the Black Hole. Hence, they both enter the Black Hole if they are located infinitely close to the event horizon. If not located close enough to the event horizon, they will return the energy of their mass and charge to the energy of two photons to the vacuum energy density from which it was borrowed in accordance with Heisenberg's Uncertainty Principle. This would imply that there would be a depletion of vacuum energy density infinitely close to the event horizon, but the Black Hole and its surroundings would not lose mass to evaporate.

4. Conclusion

After proving that the speed of light decreases in high gravity fields as too in denser mediums, we have considered the cases of Pulsars, Quasars, and Active Galactic Nuclei, to provide experimental proof that charged particles moving faster than the diminished speed of light in these high gravity regions would radiate energy due to the Cherenkov Effect that has been detected on earth as Radio Waves and X-rays. We prove that there is no experimental evidence for Hawking Radiation because its theoretical validation is based on a faulty premise.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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