Behaviour of an Electron inside M87 Black hole

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Abstract—This paper mainly deals with the properties of electron inside m87 black hole in ergo sphere layer.Amount of Magnetic field inserted by electron inside m87 black hole is found out along with the force of attraction or repulsion between two electrons inside black hole.Electric field of m87 back hole is found out using charged disk concept.Violation of energy conservation when electron is ejected from the black hole is clearly shown.Escape velocity of electron to escape from m87 black hole is also found out.

Index Terms— Drift velocity,Electric field,magnetic field,Force of attraction,Energy of conservation,Escape velocity.

1 Introduction

M87 is a super gaint elliptical galaxy. The second brightest galaxy with in the Northern Virgo cluster. It is located about 53.5 million light years from the earth.At the core is a super massive black hole which forms the galactic nucleus of m87 Galaxy. A black hole is region of space time from which gravity prevents any thing including light. Basic structure of black hole consists of 4 components they are (a)Singularity (b)Photon sphere (c) Event Horizon (d) Ergo sphere

a) Singularity: It forms the centre of black hole which can be called as nucleus of black hole

b) Photon sphere: singularity is surrounded by a layer called photon sphere . The photon sphere is a spherical boundary of zero thickness such that the photons moving along tangents to the sphere will be trapped in a circular orbit.

c) Event horizon: photon sphere is surrounded by event horizon which is called as point of no return.

d) Ergo sphere: Event horizon is surrounded by ergo sphere . In this region of a black hole It is impossible to stand still.

Figure 1:

2 Mass and Radius of M87 black hole

Mass of M87 black hole is approximately 10 billion times more than the mass of Sun which Is given by $1392377 \times 10^{40} kg$ (appr).Radius of M87 Black hole is givenBy 1.5 kpc(5kly)=$4.6285 \times 10^{19} m$

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3 Conductivity of Black hole

$$\sigma = ne|\mu_e$$

Where n= number density

μ=electron mobility of mixture of gases surrounding black hole

$$n = N_A C$$

$$n = 6.023 \times 10^{23} \times 0.04158\ mol/m^3$$

$$= 2.50 \times 10^{22}$$

The average electron mobility of mixture of gases surrounding black hole is given By 915.626μcm^2 1/v.1/s

Therefore the conductivity is given by

$$\sigma = 2.50 \times 10^{22} \times 915.626 \times 10^{-4} \times 1.6 \times 10^{19}$$

$$= 366.08\ s/m$$

4 Electric field of M87 using charged disk

$$E = \frac{\sigma}{2\varepsilon}\left(1 - \frac{z}{\sqrt{z^2 + r^2}}\right)$$

Substituting z=r

$$E = \frac{366.08}{8.854 \times 10^{-12}}\left(1 - \frac{1}{\sqrt{2}}\right)$$

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$$E = \frac{366.08}{8.854 \times 10^{-12}}(0.707)$$

$$E = 2.9234 \times 10^{13}\ N/C$$

5 Drift velocity and Drift current of an electron outside a black hole

$$\vartheta_{avg} = \mu \times E$$

$$\vartheta_{avg} = 2.676 \times 10^{16} m/s$$

$$I = nA\vartheta_Q$$

n= number of charged electrons inserted inside a black hole

$$I = 2 \times \pi r^2 \times 1.6 \times 10^{-19}$$

$$I = 2 \times 6.726 \times 10^{39} sqmt \times 1.6 \times 10^{-19}$$

$$I = 5.75 \times 10^{37} A$$

6 Magnetic field inserted by electron inside M87 black hole

$$B = \frac{\mu_0 I}{4\pi} \int_0^{wire} \frac{dl \times \hat{r}}{r^2}$$

$$B = \frac{\mu_0 I}{4\pi} \times \frac{1}{r^2} \int_0^{4.625 \times 10^{19}} 1$$

where $r^2 = d^2$

d=diameter of black hole

$$B = \frac{1.2566 \times 10^{-6} \times 5.75 \times 10^{35}}{4 \times 3.14} \times \frac{1}{3.663 \times 10^{40}} \times 4.6285 \times 10^{19}$$

$$B = 7226225 \times 10^4\ T$$

7 Drift Force of attraction between two electrons

When two electrons are inserted in m 87 black hole , These electrons are Pushed away from each other so that each electron occupys opposite corners of the black hole . The distance between two electrons is given by 2r where r is radius of black hole.

$$F = \frac{Gm_1 m_2}{r^2}$$

$$F = \frac{6.676 \times 10^{-31} \times (9.1 \times 10^{-31} \times 9.1 \times 10^{-31})}{(9.257 \times 10^{19})^2}$$

F=0

8 Violation of energy consrvation

Energy of an electron inside a Black hole

E=U+K

$$E = \frac{GMm}{r} + 0$$

$$E = \frac{G \times 2M}{r}$$

$$E = \frac{6.67 \times 10^{-11} \times 2(9.1 \times 10^{-31})}{4.6285 \times 10^{19}}$$

$$E = 2.61 \times 10^{-60} J$$

Energy of ejected electron from black hole

$$E = E_0 \mid K$$
$$E - mc^2 + 1/2mv_g^2$$

Where vg Is drift velocity

$$E = 8.19 \times 10^{-14} + 325.824$$

$$E = 2.66 \times 10^{-11} J$$

Energy of an electron inside black hole ≠ Energy of an ejected electron from the black hole.

9 Escape speed of an electron to escape from black hole

$$V - \sqrt{\frac{2GM}{R}}$$

$$V = \sqrt{\frac{2 \times 6.67 \times 10^{-11} \times 139237 \times 10^{35}}{4.6285 \times 10^{19}}}$$

$$V = 200324.98 m/s$$

10 Conclusion

All the properties i.e conductivity, drift velocity, drift current, electric field of M87 Black hole are found out theoritically. Violation of Energy conservation of an electron is clearly shown in section 8.

10 Results and discussion

When an electron is inserted in to the Ergo sphere of M87 black hole factors like conductivity, electric field , magnetic field , drift velocity and drift current are found out in the sections 3,4,6,5 respectively. Escape velocity of an electron is found out (appr.) in section 9.

References

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Figure 1:

Structure of M87 black hole